Scalable Performance Oscilloscopes

DPO70000SX Series Datasheet

DPO70000SX provides ultra-high bandwidth real time signal acquisition and analysis up to 70 GHz analog bandwidth. The patented Asynchronous Time Interleaving (ATI) architecture provides the lowest noise and highest fidelity for real time signal acquisition.

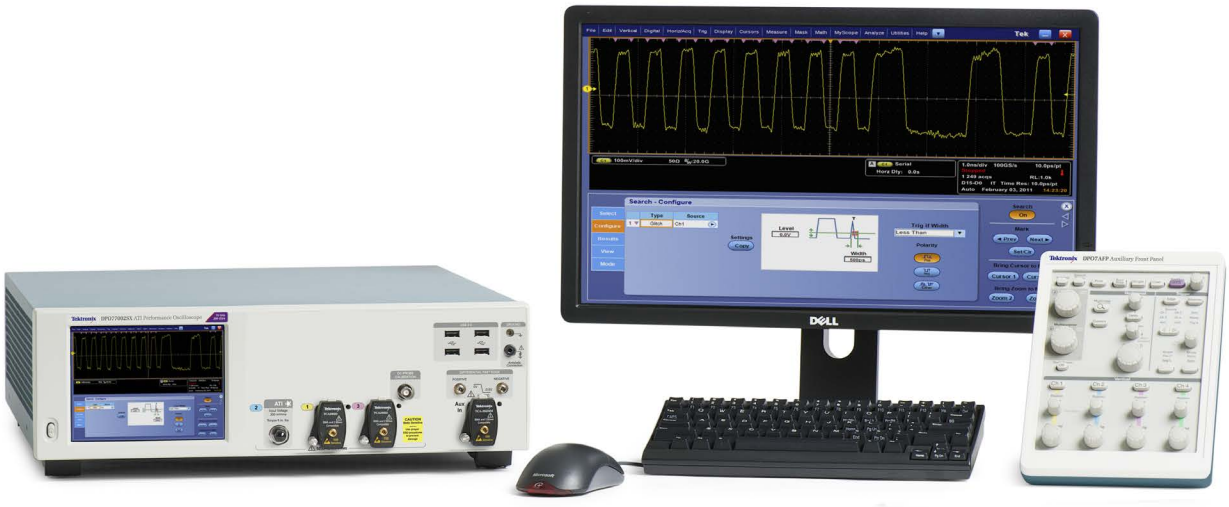
- Superior signal fidelity and excellent signal-to-noise ratio
- Stable and precise multi-channel timing for most accurate analysis
- Compact instrument package with flexibility for future expansion and simple reconfiguration

Introduction

DPO70000SX Series oscilloscopes provide the most accurate real time performance for ultra-bandwidth applications.

- Low noise, 70 GHz real time signal capture using patented ATI architecture
- Compact 5 ¼" (3U) instrument package for the most versatile multi-channel systems
- Precise, scalable performance using UltraSync multi-unit time synchronization bus
- Highest trigger performance with >25 GHz Edge trigger bandwidth, unique Envelope trigger
- 14.1 Gbps hardware serial trigger - Assures triggering on the first instance of a specified 8b/10b, 64b/66b, or generic NRZ pattern to allow isolation of pattern-dependent effects
- Bit error detector - Implemented within the trigger system, this feature provides simple bit error measurement against a defined pattern file, with no missed bits

Low noise, high fidelity signal acquisition is critical in ultra-bandwidth applications such as long-haul coherent optical, 400G datacom and wideband RF. The flagship DPO77002SX model uses ATI (Asynchronous Time Interleaving) architecture to achieve 70 GHz and 200 GS/s (5 ps/Sample) real time acquisition performance. This patented, symmetric architecture elegantly creates an inherent noise advantage over legacy bandwidth interleaving methods. The DPO70000SX provides the lowest noise, highest fidelity and maximum performance for complex optical modulation analysis, jitter and noise analysis of high speed serial signaling and frequency, phase and modulation analysis of wideband RF signals.



DPO70000SX ATI Performance Oscilloscopes

- 70 GHz, 59 GHz, or 50 GHz analog bandwidth
- Low-noise ATI architecture
- 200 GS/s, 5ps/Sample real-time sample rate

DPO70000SX TekConnect Performance Oscilloscope

- 33, 25, 23, 20, 16, or 13 GHz analog bandwidth
- 100 GS/s, 10 ps/Sample real-time sample rate
- Bandwidth upgradable to ATI 70 GHz, 59 GHz, 50 GHz models

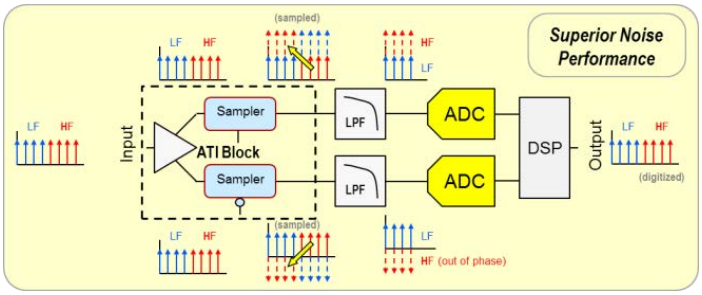
Applications

- Coherent optical modulation analysis
- Research and defense data acquisition and analysis
- 100G/400G datacom system debug
- PCIe debugging and compliance testing
- High-speed serial communications debugging and compliance testing
- PCIe, USB, Thunderbolt, HDMI, DisplayPort, and more

ATI architecture delivers lowest noise

Previous real time scope solutions for digitizing ultra-high bandwidth signals distribute signal energy to two digitizing paths, and then use DSP to reconstruct the input signal. Unlike legacy schemes, Tektronix' unique ATI architecture provides a symmetric technique that delivers all signal energy to both digitizing paths resulting in an inherent noise advantage.

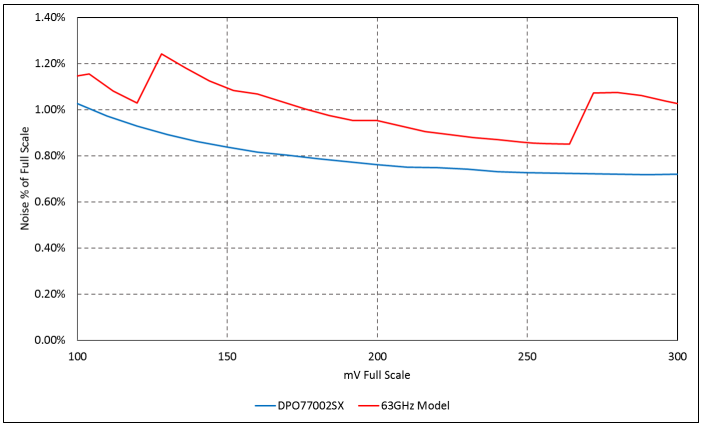
The diagram shows how an input signal enters the ATI ASIC where it is sampled and alternately delivered to each digitizing subsystem. The sample clock runs at 75 GHz and effectively folds the spectrum of the input signal about 37.5 GHz prior to digitizing. Each digitizing path operates at 100 GS/s and the folded spectrum is band limited to <40 GHz to meet Nyquist criteria. The alternating phase of the sampler has the effect of inverting signal phase 180° in one digitizing path, which provides significant benefit in reconstructing the final digitized signal.



With two copies of the entire signal energy digitized, the signal spectra are "unfolded" using a DSP equivalent of the sampling process and combined to reproduce the input signal. Because two copies of the signal are being combined the process effectively averages them together, reducing random noise. Phase-inversion introduced by the sampling process causes intermediate frequency components to directly cancel one another, simplifying reconstruction and calibration.

Thus, ATI architecture provides an inherent SNR advantage over legacy digital-bandwidth interleaving techniques. These techniques immediately split an input signal into upper and lower bands of frequencies. This divides the power and the upper frequency band must be mixed down prior to digitizing while the lower band is directly digitized. This asymmetric approach can make signal reconstruction and calibration more difficult and lead to errors in pass-band frequency or phase response. The division of power removes the opportunity to reduce signal noise. ATI alleviates these issues by using a unique symmetric architecture.

A comparison of baseline noise between the Tektronix DPO77002SX and another vendor's 63 GHz model, with both instruments set to 60 GHz bandwidth, demonstrates the effectiveness of ATI at providing the lowest noise acquisition.

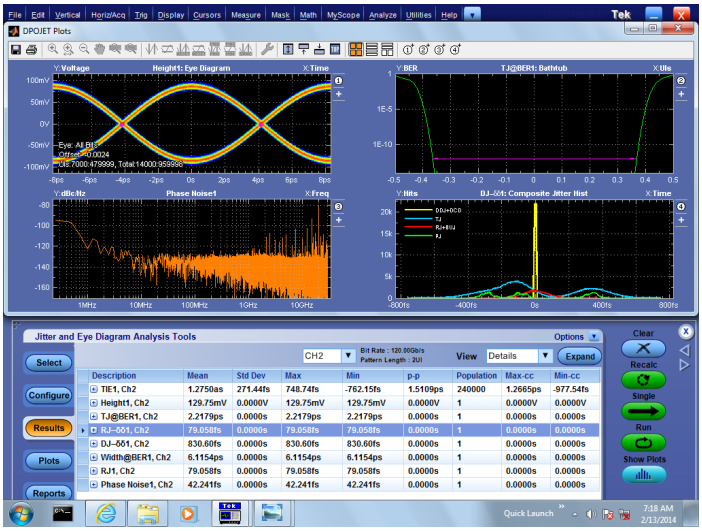


DPO77002SX vs. other vendor's 63 GHz model: Baseline noise % of FS vs. mV_{FS} setting, with trace centered, at 60 GHz BW, maximum sample rate setting (200 GS/s or 160 GS/s)

JNF performance

An all-new master sample clock design which provides the remarkably low sample clock jitter of 65fs_{RMS}, combined with the very low noise performance achieved with ATI, allows the DPO77002SX to reach new levels of jitter noise floor performance. The JNF at 300 mV_{FS} is a mere 123 fs_{RMS}, which even rivals lower bandwidth instruments.

The figure shows jitter analysis of 60 GHz sine wave applied to the ATI input. The result shows a clean eye with random jitter RJ <80 fs_{RMS}.

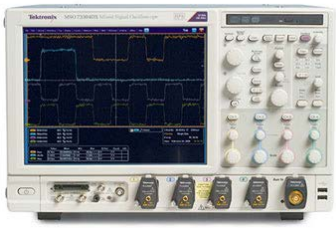


Compact ultra-performance oscilloscope

DPO70000SX Series models establish a unique compact oscilloscope package that enables unprecedented workspace efficiency and mounting versatility. The SX series provides a differentiated approach to ultra-bandwidth real time acquisition that aligns with user trends toward large external monitors, higher degrees of automation and increased separation of data collection and data analysis workspaces.

Stand-alone DPO70000SX compact models provide functionality equivalent to their bench counterparts (DPO70000DX) at half the height through addition of external display, keyboard and mouse. SX series models can host Advanced Analysis software and be automated using internal or external control just as their bench counterparts.

The DPO77002SX 70 GHz ATI Performance Oscilloscope provides one channel at 70 GHz, 200 GS/s acquisition performance or two channels at 33 GHz, 100 GS/s acquisition. The instrument includes a 70 GHz, 1.85 mm low-noise ATI input channel as well as general purpose TekConnect 2.92 mm inputs for versatile probing and signal conditioning options to 33 GHz.



The DPO73304SX model provides two channels at 33 GHz, 100 GS/s acquisition or four channels at 23 GHz, 50 GS/s real time acquisition performance. This model provides acquisition performance similar to the DPO73304DX bench model, but in the new compact instrument form-factor.

All models in the DPO70000SX Series achieve the highest level of trigger performance available in real time oscilloscopes, >25 GHz edge trigger performance and <40 ps glitch trigger performance. An innovative new Window trigger type enables triggering on the envelope of RF signal bursts with time-qualification to discriminate envelope width. Industry-leading pulse-width timer performance enables the most precise discrimination of specific bit-widths in high speed serial data streams and detection of "runt" pulses in the midst of pseudo-random signaling. The DPO70000SX Series Auxiliary Trigger input provides low-jitter edge triggering and uses TekConnect accessories for a wide variety of signal conditioning solutions.

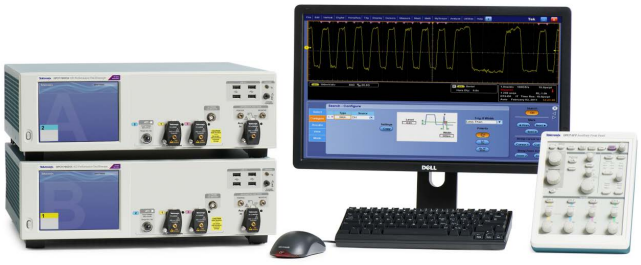
Optimal usability

Less than half the height of bench models

DPO70000SX Series instruments are contained in a 5 ¼" (3U) package that optimizes space usage and enables the most versatile range of mounting configurations. Two DPO70000SX instruments stack in less height than similar-class bench instruments, yet achieve higher measurement performance.

Complete standalone oscilloscope

Though compact, SX models provide full standalone oscilloscope functionality and performance. They can directly host Tektronix' Advanced Analysis applications for tasks such as jitter, noise, optical modulation or spectral analysis and do not require a separate processor or control unit.



2 x 70 GHz, 4 x 33 GHz configuration with monitor and auxiliary front panel

Familiar scope controls where you want them

The DPO7AFP Auxiliary Front Panel is a valuable usability accessory that compliments the compact instrument package by enabling users to operate with familiar controls without requiring access to the front of an instrument.

The Auxiliary Front Panel provides the same control set embedded in DPO/DSA/MSO/7000/70000 bench instruments as a separately packaged USB peripheral. This accessory enhances usability even when the instrument front panel may be obscured due to mounting location.

Remote desktop operation

As with current bench-model DPO/MSO70000 Series instruments, DPO70000SX models can be operated remotely over a network using Windows® Remote Desktop. Use the Windows Remote Desktop utility to access your oscilloscope from across the lab or across the globe.

Precision synchronization for multi-unit systems

DPO70000SX Series instruments include the Tektronix UltraSync multi-unit time synchronization bus. UltraSync is used to synchronize sample clock, trigger and run-stop control across multiple units with performance equivalent to that found in monolithic scopes. UltraSync cables are available in 1 meter and 2 meter length to maximize configuration and layout versatility while preserving timing integrity of a multi-unit system.

- 12.5 GHz Sample Clock Reference
- Coordinated Trigger
- High speed data path

The UltraSync bus consists of three elements, each providing an important element of precise multi-unit operation:

- UltraSync includes a 12.5 GHz Sample Clock Reference signal sourced by the Master and used by each Extension to synchronize sample placement in the digitizing process.

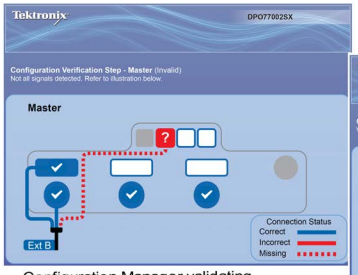
UltraSync connection on instrument with Master role

UltraSync connection on instrument with Extension role

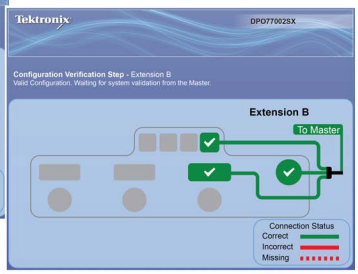
- The Trigger bus provides Run-Stop control for all members of a multi-unit configuration and enables the trigger source to be from a Master or Extension unit.
- Control & data transfer from Extension units to the Master are managed with a PCIe, Gen 2, x4 link capable of 2 GB/s data transfer rate.

When operating in a multi-unit instrument configuration, one DPO70000SX has the role of Master, controlling one or more units operating in Extension mode. Any DPO70000SX model can operate as a standalone oscilloscope or serve as Master or Extension in a multi-unit configuration. Roles are determined by UltraSync cabling and no additional elements are needed. This allows users to decouple multi-unit configurations at any time and operate instruments in a standalone fashion without requiring a control unit or other accessories. Or, standalone units can be easily combined by simply adding UltraSync cables between Master and Extension.

During startup of a multi-unit configuration a Configuration Manager application validates Master-Extension cabling and provides graphical feedback if elements are missing or misconfigured. Following validation, the system presents the TekScope user interface where waveforms from Master and Extension units are gathered for display and analysis using built-in features and Advanced Analysis applications.



Configuration Manager validating Master connections



Configuration Manager validating Extension connections

Scalable performance and versatile configurations

DPO70000SX multi-unit modes enable a variety of extended performance and increased channel-count configurations. Master-Extension configurations provide additional input channels synchronized to the same degree of precision as internal channels and controlled from a single user interface as an interactive instrument or programming interface in automated applications.

This scalable approach to performance allows users to purchase performance suitable for today's requirements, such as four channels of 33 GHz, 100 GS/s acquisition while also having two channels with 70 GHz, 200 GS/s performance suitable for next-generation designs. Subsequently, two additional units can be added for a total of four channels at 70 GHz, 200 GS/s. Units in this four-unit configuration can be separately deployed as pairs or standalone units at any time to meet other test demands.

The DPO77002SX also offers a unique value proposition in single-channel 70 GHz, 200 GS/s applications such as RF analysis or pulsed laser studies. In these cases a user can purchase a single unit for 70 GHz channel performance along with two channels at 33 GHz. Additional units can be purchased at a later time and combined using UltraSync if higher channel count is needed.

The following multi-unit configurations are supported:

2 DPO77002SX: 2 Ch @ 70 GHz, 200 GS/s or 4 Ch @ 33 GHz, 100 GS/s

4 DPO77002SX: 4 Ch @ 70 GHz, 200 GS/s or 8 Ch[1] @ 33 GHz, 100 GS/s

2 DPO75902SX: 2 Ch @ 59 GHz, 200 GS/s or 4 Ch @ 33 GHz, 100 GS/s

4 DPO75902SX: 4 Ch @ 59 GHz, 200 GS/s or 8 Ch[1] @ 33 GHz, 100 GS/s

2 DPO75002SX: 2 Ch @ 50 GHz, 200 GS/s or 4 Ch @ 33 GHz, 100 GS/s

4 DPO75002SX: 4 Ch @ 50 GHz, 200 GS/s or 8 Ch[1] @ 33 GHz, 100 GS/s

2 DPO73304SX: 4 Ch @ 33 GHz, 100 GS/s or 8 Ch [1] @ 23 GHz, 50 GS/s

4 DPO73304SX: 8 Ch[1] @ 33 GHz, 100 GS/s or 16 Ch[1] @ 23 GHz, 50GS/s

2 DPO72504SX: 4 Ch @ 25 GHz, 100 GS/s or 8 Ch[1] @ 23 GHz, 50 GS/s

4 DPO72504SX: 8 Ch[1] @ 25 GHz, 100 GS/s or 16 Ch[1] @ 23 GHz, 50GS/s

2 DPO72304SX: 4 Ch @ 23 GHz, 100 GS/s or 8 Ch[1] @ 23 GHz, 50 GS/s

4 DPO72304SX: 8 Ch[1] @ 23 GHz, 100 GS/s or 16 Ch[1] @ 23 GHz, 50GS/s

2 DPO72004SX: 4 Ch @ 20 GHz, 100 GS/s or 8 Ch[1] @ 20 GHz, 50 GS/s

4 DPO72004SX: 8 Ch[1] @ 20 GHz, 100 GS/s or 16 Ch[1] @ 20 GHz, 50 GS/s

2 DPO71604SX: 4 Ch @ 16 GHz, 100 GS/s or 8 Ch[1] @ 16 GHz, 50 GS/s

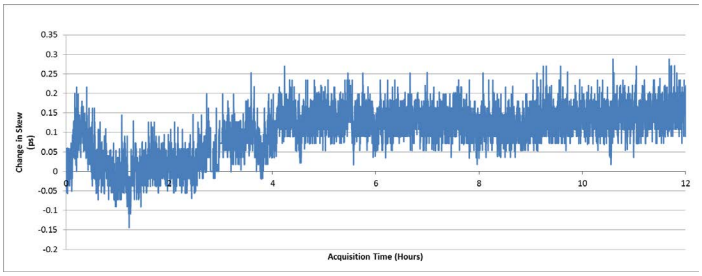
4 DPO71604SX: 8 Ch[1] @ 16 GHz, 100 GS/s or 16 Ch[1] @ 16 GHz, 50 GS/s

2 DPO71304SX: 4 Ch @ 13GHz, 100 GS/s or 8 Ch[1] @ 13 GHz, 50 GS/s

4 DPO71304SX: 8 Ch[1] @ 13 GHz, 100 GS/s or 16 Ch[1] @ 13 GHz, 50 GS/s

Skew Stability

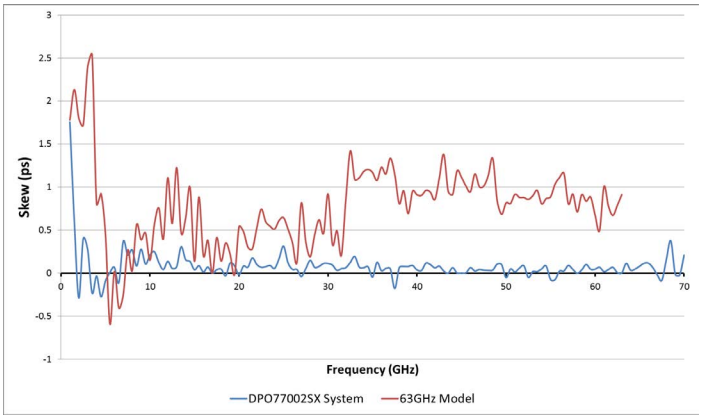
UltraSync provides outstanding integration and time alignment between units in a multi-unit stack. Once channels have been deskewed in a multi-unit stack, skew is very stable over time and temperature. The specification for skew stability is ≤250 fs_{RMS}. The following DPO77002SX skew measurement plot shows that even when including the startup temperature stabilization period (approximately 1 hour), the pk-pk variation is about 400 fs, and is about 350 fs pk-pk after the 1-hour warm-up period. This plot also shows exceptional consistency over this 12-hour data collection.



Change in channel-to-channel skew of DPO77002SX system over time.

Another important aspect of skew is how the phase relationship between two channels varies with changing frequency (group delay effects). The following plot compares the performance of a DPS77004SX 70 GHz two-unit system against the performance of another vendor's 63 GHz frequency-interleaved channels. What you see here is that the UltraSync two-channel skew performance dramatically surpasses the performance of another vendor's single 63 GHz model containing two channels.

[1] Maximum of 4 channels displayed on-screen. Access to additional channels data available through program interface.



Channel skew vs. Frequency comparison between DPO77002SX system and other vendor's 63 GHz model.

Short signal path

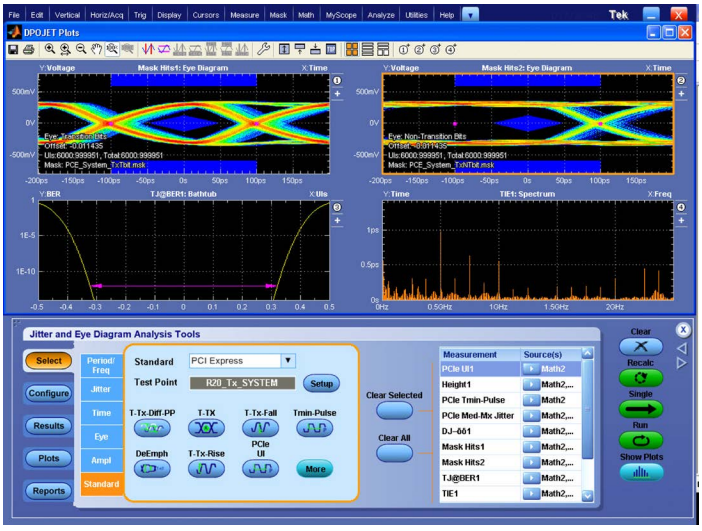
Minimizing input signal path length is especially important when working at 70 GHz ultra-high bandwidth. The compact nature of DPO70000SX creates more versatile mounting options when co-locating instrument and device under test (DUT). Options such as the Auxiliary Front Panel and Remote Desktop connection allow further flexibility by eliminating the need for direct access to the instrument front panel once connected. As a result, the SX series enables the broadest range of options when dealing with a variety of DUT configurations as compared to classic bench instruments.

Input signal path length may be minimized in multi-unit configurations by inverting one unit of a pair. The low, central location of the 70 GHz ATI input provides very small input connector spacing when operating units in this configuration.

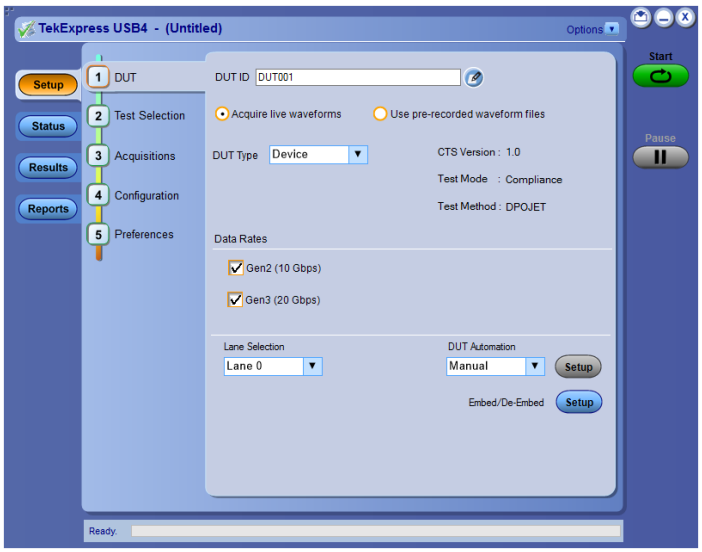
Instruments can also be arranged at various angles to suit DUT layout, such as at right angles for card-and-backplane situation or face-to-face around a small DUT. Layouts such as this create the shortest input signal path and maximize SNR. In addition, effects of signal path elements such as cables and adapters can be characterized and removed using the Serial Data Link Analysis application to obtain the best analysis results and insight.

Applications

High-Speed Serial



PCI Express® Transmitter Compliance and Debug (Options PCE3, PCE4, PCE5, PCE6) *– Analyze the performance of your PCI Express® Rev 1.0, 2.0, 3.0, 4.0, 5.0, or 6.0 design with comprehensive test support. Using DPOJET and PAMJET Options PCE3, PCE4, PCE5 and PCE6 enables tests that conform to PCI-SIG standards.*



TekExpress® USB4 Automated Test Software (Option USB4) *- The TekExpress® USB4 Compliance and Debug solutions provide an easy way to validate and characterize the emerging USB4 Router-Host, USB4 Router-Device, and USB4 Hubs as per the USB4 Electrical Compliance Test Specification (CTS). Tektronix MSO/DPO70000DX and DPO70000SX Series Oscilloscope (bandwidth ≥ 23 GHz) supports the Tektronix USB4 Compliance and Debug solutions.*

Datacom measurements

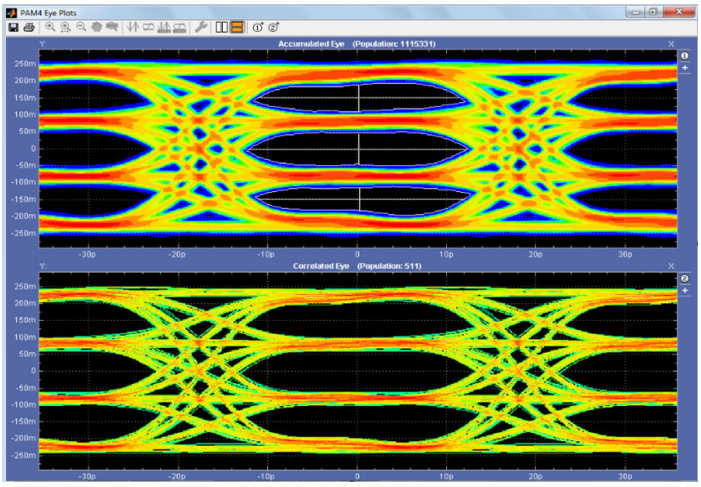
PAM4 and NRZ measurements

The throughput of Datacom networks continues to increase. Tek's DPO70000SX is ready to perform standards validation for today's 25/28G industry standards and beyond (see chart below). The powerful combination of DPO70000SX, DPOJET Jitter and Noise Analysis, and the SDLA Serial Data Link Analysis tool performs accurate de-embedding and eye diagram analysis

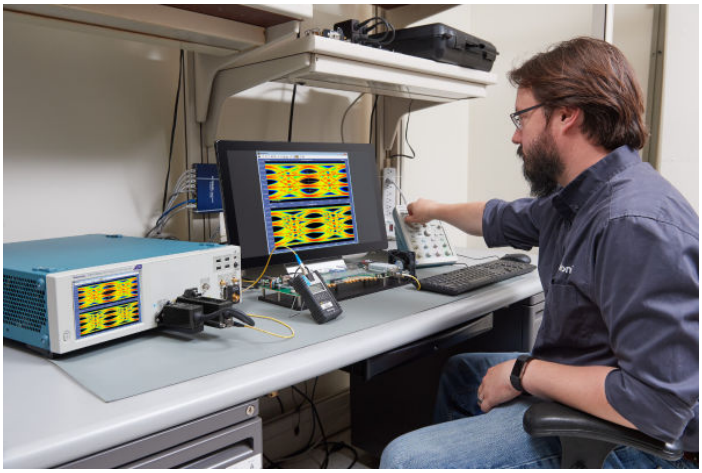
for these key Datacom standards. The 50 GHz to 70 GHz models provide ample bandwidth for Bessel-Thomson filter responses.

Datacom standards	Recommended bandwidth	Tektronix scope model
Ethernet 10GBASE KRn 100GBASE KR-4, CR-4 25 Gb Phy KR, CR for 100G	25 GHz 59 GHz 59 GHz	DPO72504DX DPS75904SX DPS75904SX
Fibre Channel 16Gb 32Gb	30 GHz 45 GHz	DPS75004SX DPS75004SX
Infiniband EDR 25Gb	50 GHz	DPS75004SX
OIF-CEI 3.0 CEI-25G	70 GHz	DPS77004SX
OIF-CEI 3.1 CEI-56G (PAM4) CEI-56G (NRZ)	70 GHz 70 GHz	DPS77004SX DPS77004SX

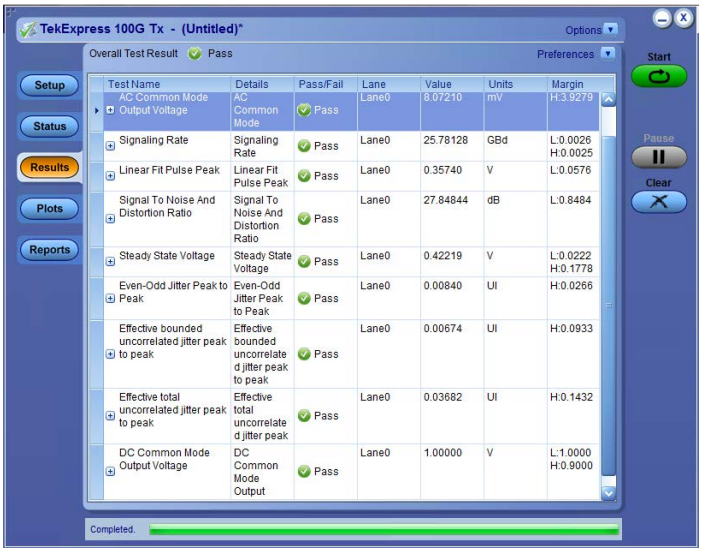
With 400G networking, serial data transmission speeds are now reaching 56 Gb/s per channel, making NRZ signaling techniques less practical. The bandwidth efficient PAM4 (4-level pulse amplitude modulation) signaling is being widely used to achieve this new performance level. Accurate PAM4 validation is best conducted using the DPO70000SX Series, with its industry-leading low-noise ATI technology, to achieve the best test margin on your measurement results. For analysis of PAM4, the DPO70000SX Options PAMJET-E and PAMJET-O combine industry leading equalization tools and a robust built-in software based clock recovery, which is essential to recovering complex timing and performing analysis of high ISI PAM4 signals.



Option PAMJET-E offers electrical measurements and option PAMJET-O offers optical measurements. Both comply with IEEE and OIF specifications. Optical interfacing is provided through the use of the DPO7OE Series optical probes, which include ORR filters.



IEEE 802.3bj (KR4/CR4) and IEEE 802.3bm (CAUI4) Electrical Real Time Transmitter Compliance and Characterization Solution (option 100G-TXE) *- TekExpress 100G-TXE automation provides turnkey testing and debug of 100G Ethernet's three most common electrical interfaces. Tools for 100G- KR4/CR4/CAUI4 are brought together in a single 100G-TXE option to support silicon designers and system designers as they perform KR4 and CR4 validation.*



Bit error detection

The bit error detector (option BITERR) is a generic simple NRZ bit error detector for serial data testing, covering data rates between 600 Mbps and 14.1 Gbps. It detects bit errors on a repeating pattern being sent by a serial transmitter. This feature utilizes the trigger system hardware, rather than waveform acquisition, so every bit is detected and verified; there are no blind periods or missed bits during bit error analysis. A pattern match file is used to define the expected incoming pattern. PRBS patterns are predefined, but users can also create their own unique pattern match files. Note that this optional feature is not protocol aware, and does not detect frame/symbol/character errors. When a bit error is detected, the oscilloscope triggers a waveform acquisition, resulting in a capture of the waveform containing the bit error. If the oscilloscope also has an optional serial decoder for the serial data stream being tested (for example, 8b10b), the acquired waveform can include decoded data, making analysis and debug of the error easier. Requires option ST14G.

Bit Error Detector (option BITERR) *- Provides statistics on bits counted and number of errors detected, as well as displaying waveform data upon detection of a bit error. As shown here, the Bit Error Detector can be combined with optional serial data decoders to facilitate debug and diagnosis of errors.*

Link Training

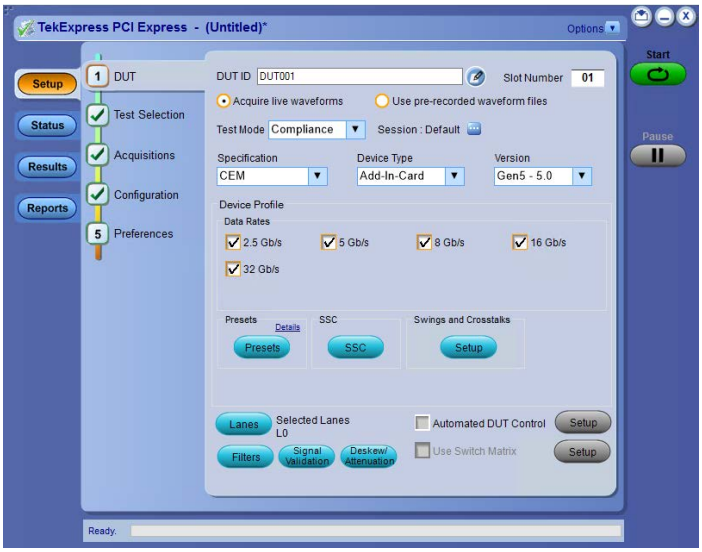
High Speed Serial Link Training Analysis - option HSSLTA - is a tool for verifying and debugging link training operation on 10 Gb through 200 Gb Ethernet links. It offers a powerful debugging capability for network equipment providers and silicon vendors concerned about interoperability issues in their designs. Link training is a complex sequence of negotiations between transmitter and receiver to determine optimal transceiver settings. HSSLTA uses the power of DPO70000SX triggering to identify link training exchanges between devices, then analyzes and displays the protocol, timing, and PHY signaling associated with link negotiation. This insight allows designers to verify the link training process and to quickly pinpoint problems when links fail to train.

The Most Efficient way to isolate link training issues:

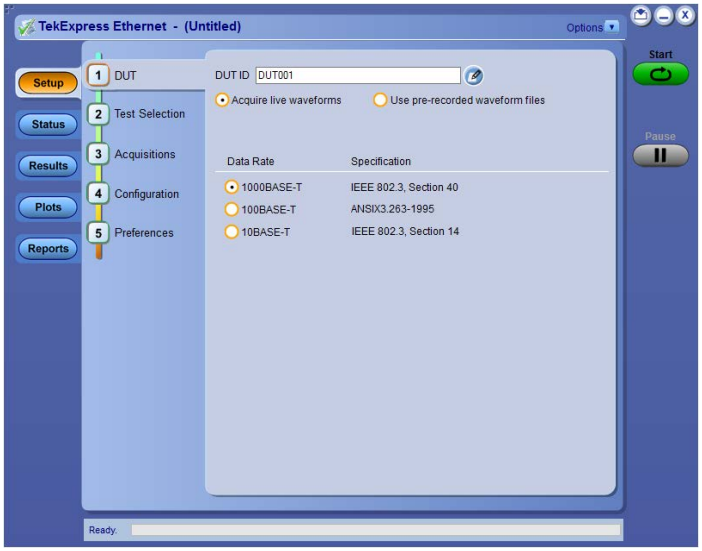
- Real time capture of PHY-layer signaling provides detailed insight
- Control channel filtering stores essential conversation and removes redundant copies so only significant elements seen
- Time-stamped control channel elements provide further insight into link training process
- Linkage to PHY signaling provides quick navigation for exploring

Link Training (option HSSLTA) - Offers an interactive Results Table based on FastFrame records. *- Fast-Frame Records: Time-aligned Hex and Bit-level decode, Marks (Frame, Control Channel, and Training Data). Results Table: All negotiation data is captured in Results Table, Click row to view waveform, Scroll through table rows, Verify Negotiation Requests/Responses, and Export Negotiation Data.*

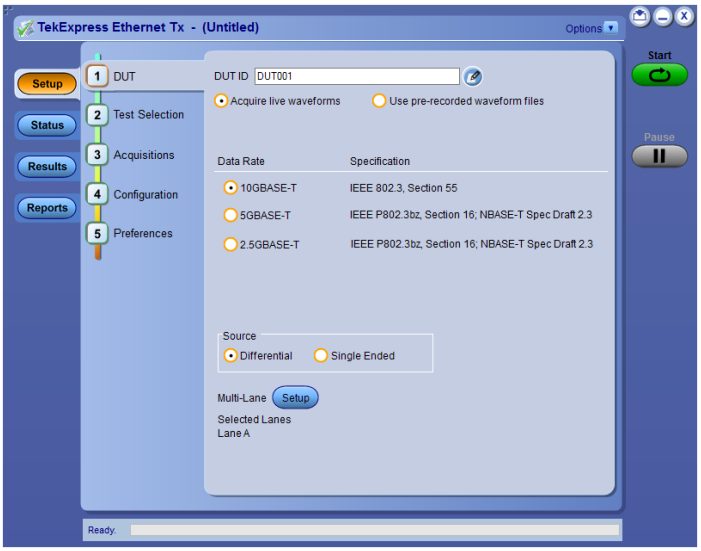
Compliance software



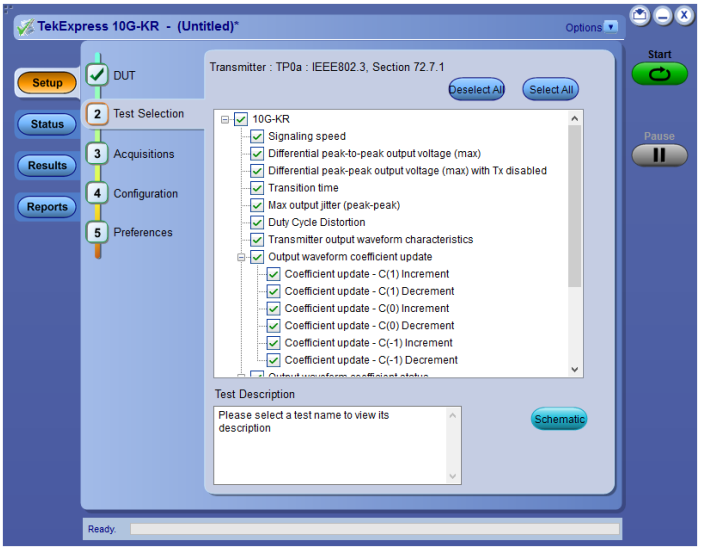
TekExpress® PCI Express Gen 1/2/3/4/5/6 Automated Test Software (Options PCE3, PCE4, PCE5, PCE6) *- Provides the most comprehensive solution for PCI Express transmitter compliance testing from legacy Gen1 to most recent Gen6 BASE (as of Oct 2022). Covering troubleshooting and validation of PCI Express devices corresponding to the PCI-SIG specifications. The application automates selection of appropriate fixture de-embed, reference channel emulation filters, and measurement selections based on test type, device data rate, transmitter equalization, link width, and selected probes. TekExpress includes compliance automation solution that integrates the PCI-SIG's Sigtest test software with Tektronix DPOJET-based PCI Express Jitter and Eye Diagram, SDLA Serial Data Link Analysis Visualizer analysis tools for debug, as well as PAMJET for Gen6 PAM-4 modulation analysis. Results are presented in a comprehensive HTML format for engineering test documentation.*



Ethernet Compliance Test Solution (Option CMENET3) *– Receive full PHY layer support for Ethernet variants 10BASE-T, 100BASE-TX, and 1000BASE-T with the comprehensive, integrated Tektronix® Ethernet tool set. Analog verification, automated compliance software, and device characterization solutions are all included.*

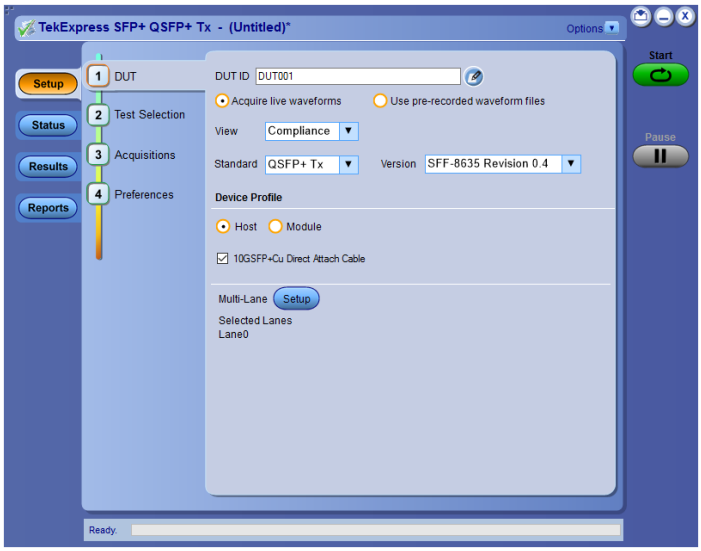


TekExpress Ethernet Tx (Options NBASET, XGBT2) *- Automates 10GBASE-T, NBASE-T, and IEEE802.3bz (2.5G/5G) physical medium attachment (PMA) and physical-layer (PHY) electrical testing to provide a fast and accurate way of testing your Ethernet designs.*



10GBASE-KR/KR4 Compliance and Debug Solution (Option 10G-KR) *- Automated compliance measurements for IEEE 802.3ap-2007 specifications. This option includes an automated compliance solution and debugging with DPOJET. The automated test setup measures transmitter equalization levels generating 12 results for each tap and 120 results for 9 different measurements in approximately 15 minutes.*

SFP+/QSFP+ Transmitter Compliance and Debug Solution (Option SFP-TX and SFP-WDP) - Automates compliance testing of devices built using the SFF-8431 & SFF-8634 specifications. Transmitter Waveform Distortion Penalty (TWDPc) measurements for copper are available with Option SFP-WDP.



TekExpress SFP+ QSFP+ Tx (Options SFP-TX, SFP-WDP) *- TekExpress SFP+ QSFP+ Tx is developed on a Real Time Oscilloscope platform, which is the platform of choice for engineers designing their products around SFF-8431 & SFF-8634 technology. Option SFP-TX and SFP-WDP enable both an Automation Solution (for Compliance) and DPOJET Option (for Debug), Users can save up to 80% on testing time compared to manual testing. TWDPc - Transmitter Waveform Distortion Penalty for Copper Measurements are available with Option SFP-WDP. SFF-8431 SFP+ TWDPc based Matlab code is integrated into the SFP-WDP option to make sure Engineers can use this measurement in the automated setup.*

Coherent optical

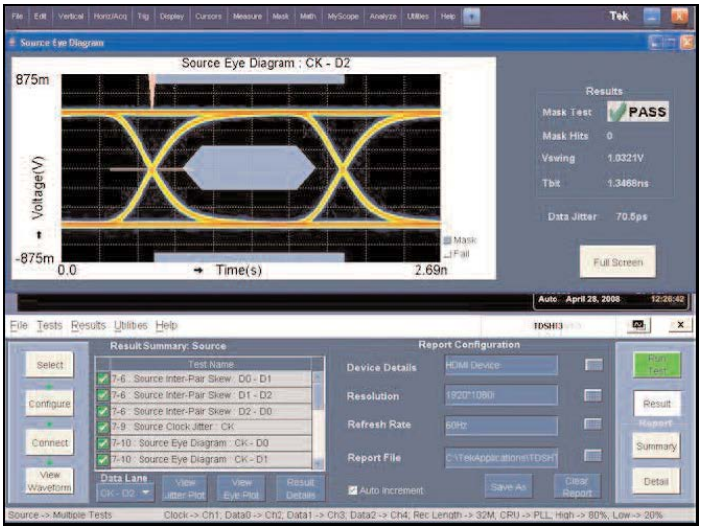
Coherent optical modulation analysis

Tektronix DPO70000SX oscilloscopes are ideal for modulation format analysis of 400 Gb/s and Terabit-based coherent optical networking systems. The unique architecture enables scalability to grow instrument performance by adding channels or more bandwidth; test 100 G cost effectively now and expand into 400 G or 1 Terabit later. The DPO70000SX low profile reduces concerns of signal loss in system connectivity on your coherent measurements by placing the optical receiver as close as possible to the instrument's input channel.

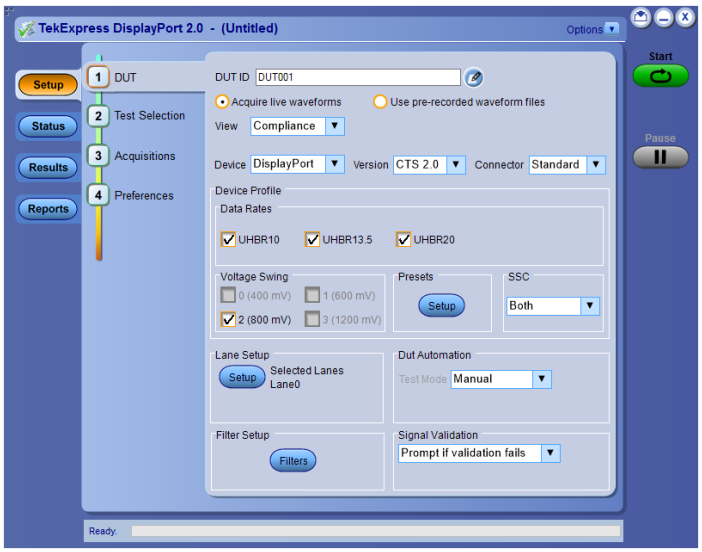
More accurate modulation analysis starts with a lower Error Vector Magnitude (EVM) floor in the instrument. The DPO70000SX Oscilloscope utilizes ATI technology to provide the industry's lowest noise floor supporting these measurements. In addition, the system is achieving four channels of full 70 GHz Bandwidth at 200 GS/s per channel, providing a very rich analysis environment.

- 70 GHz Bandwidth on 4 Channels for 1 Terabit/s systems
- Industry-best lowest noise for low EVM
- 200 GS/s sampling on 4 channels for phase tracking
- Compact form factor with scalability for channel & bandwidth

Display

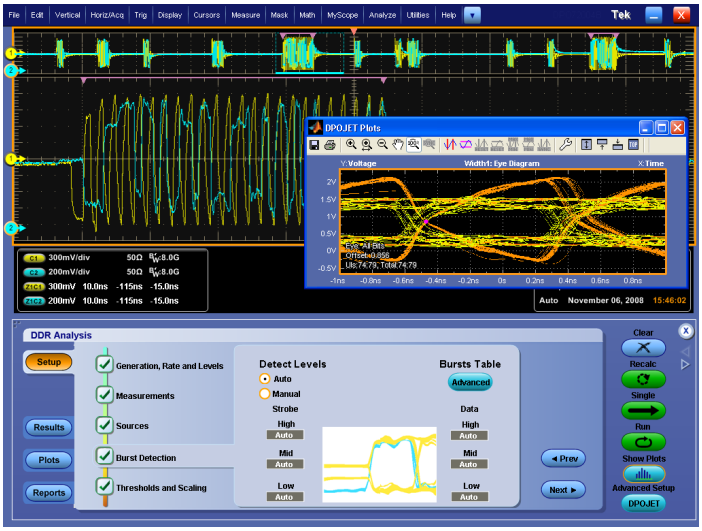


HDMI Compliance Test Solution (Option HT3) *– A fast, efficient solution for HDMI compliance measurement challenges, no matter if you are working on a Source, Cable, or Sink solution. This application provides all the HDMI compliance test solutions you need to ensure quality and interoperability.*

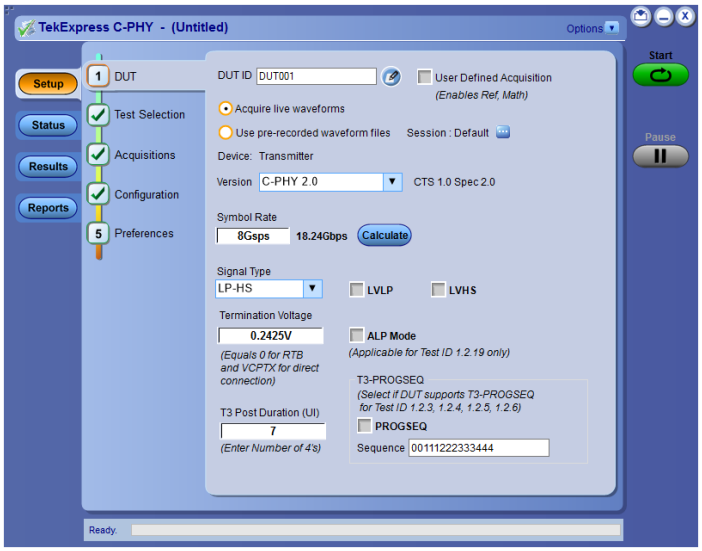


DisplayPort Compliance Test Solution (Option DP20) *– Tektronix provides the most comprehensive solution to serve the need of engineers designing DisplayPort silicon for computer systems and embedded systems, as well as for those who are validating the physical-layer compliance of DisplayPort devices as per the DisplayPort 2.0 Compliance Test Specification. Tektronix TekExpress DisplayPort 2.0 pre-compliance/debug solution help the customers to test their DP2.0 DUTs. The Tektronix Opt. DP20 application is compatible with Tektronix MSO/DPO70000DX and DPO70000SX Series oscilloscopes that are designed to meet the challenges of the next generation of display standards such as HDMI and DisplayPort.*

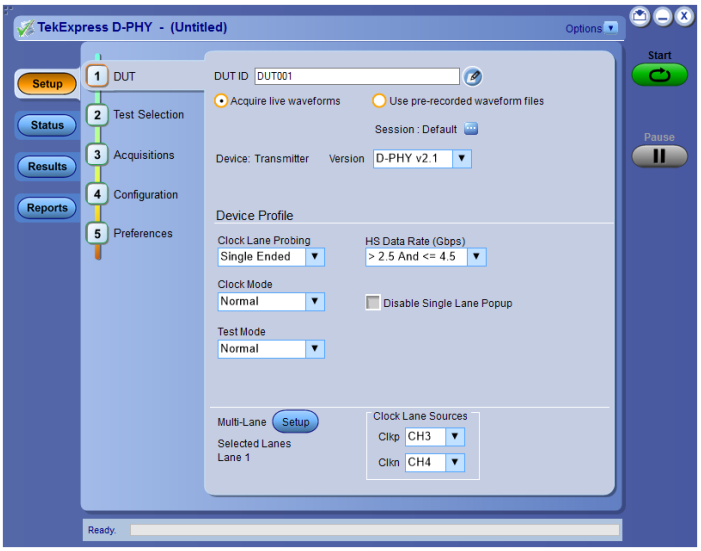
Mobile computing



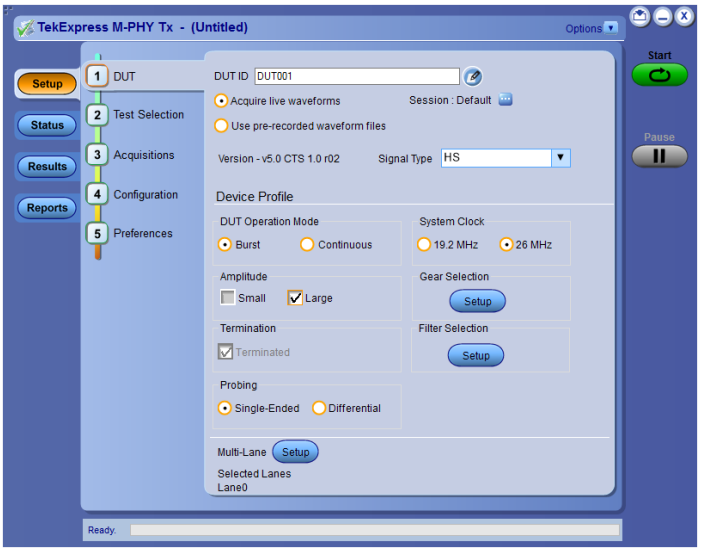
DDR Memory Bus Analysis (Options DDRA, DDR-LP4) *– Automatically identify DDR1, LPDDR1, LPDDR2, LPDDR3, DDR2, DDR3, DDR4, LPDDR4/LPDDR4X, and GDDR3 Reads and Writes and makes JEDEC conformance measurements with pass/fail results on all edges in every Read and Write burst. DDRA provides capabilities for measurements of clock, address, and control signals. In addition to enabling conformance testing DDRA with DPOJET is the fastest way to debug complex memory signaling issues. DDRA can also use the Command/ Address lines to trigger on specific read/write states when running on the MSO70000DX Series Mixed Signal Oscilloscope, which offers 16 channels of digital logic probing.*



TekExpress C-PHY (Option CPHY20) *- TekExpress® C-PHY application offers a complete physical layer test solution for transmitter conformance and characterization as defined in the MIPI C-PHY v2.0, v1.1 and v1.0 specifications. The TekExpress C-PHY solution provides an easy way to measure and characterize C-PHY data links.*



TekExpress D-PHY (Options DPHY12, DPHY21) *- TekExpress® D-PHY application offers a complete physical layer test solution for transmitter conformance and characterization as defined in the MIPI D-PHY version 1.2 and version 2.1 specifications. The automated test solution provides an easy way to test, debug and characterize the electrical and timing measurements of D-PHY data links.*



TekExpress M-PHY Tx (Options MPHY40, MPHY50)*– TekExpress M-PHY Tx provides support for 100% of tests as per Spec 5.0. This solution is designed for engineers doing verification and validation as per the CTS for High Speed (HS)-Gear1, Gear2, Gear3, Gear4, and Gear5 for MPHY50 and HS-Gear1, Gear2, Gear3, and Gear4 for MPHY40. It also supports UFS4.0 reference Clock measurements in both Option MPHY50 and Option MPHY40 products.*

RF

With its low noise and flat frequency response to 70 GHz, the DPO70000SX opens opportunities for measurement and analysis of wideband RF signals.

SignalVu® vector signal analysis

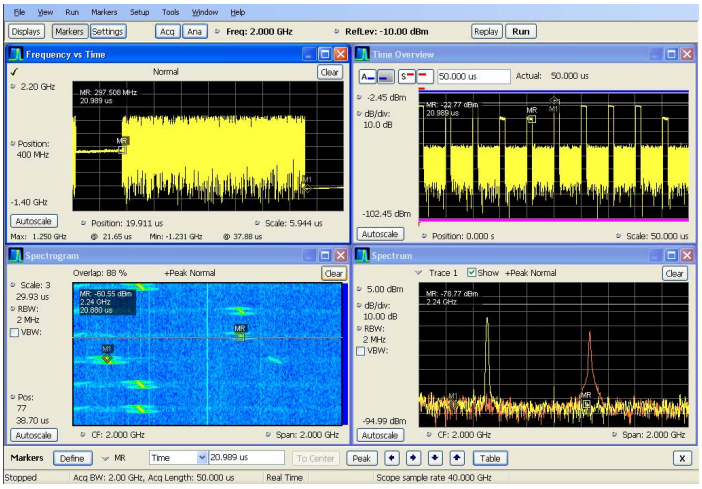
When vector signal analysis of RF or baseband signals are needed, the optional SignalVu application enables measurements in multiple domains (frequency, time, phase, modulation) simultaneously. SignalVu measurements are fully correlated with the scope's time domain acquisition and triggering. Time domain events, such as commands to an RF subsystem, can be used as trigger events, while the subsystem's RF signal can be seen in the frequency domain.

In addition to spectrum analysis, spectrograms display both frequency and amplitude changes over time. Time-correlated measurements can be made across the frequency, phase, amplitude, and modulation domains. This is ideal for signal analysis that includes frequency hopping, pulse characteristics, modulation switching, settling time, bandwidth changes, and intermittent signals.

SignalVu can process RF, I and Q, and differential I and Q signals from any oscilloscope inputs. Math functions applied by the oscilloscope are also used by SignalVu allowing users to apply custom filtering prior to vector signal analysis.

The Microsoft Windows environment makes the use of this multi-domain analysis even easier with an unlimited number of analysis windows, all time-correlated, to provide deeper insight into signal behavior. With a user interface that adapts to your preferences (keyboard, front panel, touch screen, and mouse), SignalVu is easy to apply for both first-time users and experienced hands.

Time-correlated, multi-domain view provides a new level of insight into design or operational problems not possible with conventional analysis solutions. Here, the hop patterns of a narrowband signal can be observed using Spectrogram (lower left) and its hop characteristics can be precisely measured with Frequency vs Time display (upper left). The time and frequency responses can be observed in the two right-hand views as the signal hops from one frequency to the next.



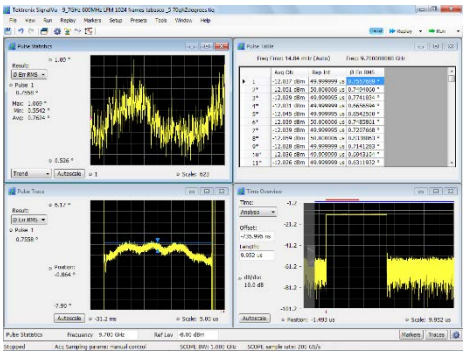
Radar and high frequency-based analysis

The low-noise, high bandwidth DPO70000SX Series Oscilloscope is ideal for high frequency FFT-based measurement analysis. When combined with the powerful SignalVu software analysis option, the DPO70000SX instrument provides FFT (fast fourier transform) measurement capability up to 70 GHz. With its scalable instrument architecture, RF engineers can obtain a single channel unit for RF input-only measurements and grow to multi-unit configurations for comprehensive RF system validation.

Examples of high-frequency RF measurements with the DPO70000SX include:

- Chirp Linearity measurements on Radar signals (see below figure)

- Wireless LAN measurements on UEEE802.11ad/ay (64.8GHz carrier frequency)
- Monitor & debug satellite communications over K-Band (20-40 GHz)

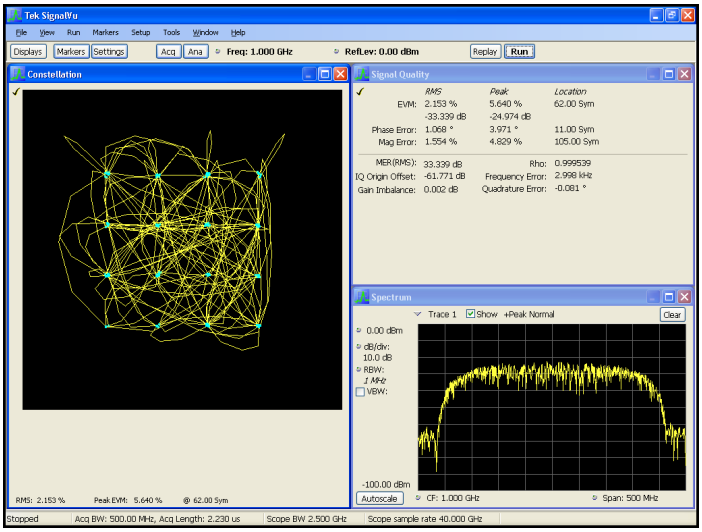


Once low-noise waveform data is captured by the 70 GHz DPO70000SX, SignalVu can be used to demodulate the signal, and display a constellation diagram and Error Vector Magnitude (EVM) measurement and other needed measurements. SignalVu also provides detailed analysis in multiple domains as additional options, such as pulse analysis and settling time for Radar systems work, digital modulation analysis and flexible OFDM analysis for emerging modulation standards, as well as AM/FM/PM modulation and audio measurements for lower bandwidth requirements.

- Industry-low noise enables low EVM floor
- 70 GHz provides wide dynamic range and accurate chirp linearity
- Integrated FFT & Phase Plot creation provides fast, accurate frequency domain measurements

Options tailored for your wideband applications

SignalVu vector signal analysis software offers options to meet your specific application, whether it be wideband radar characterization, broadband satellite, or spectrum management. SignalVu Essentials (Opt. SVE) provides the fundamental capability for all measurements and is required for pulse analysis (Opt. SVP), settling time (Opt. SVT), digital modulation analysis (Opt. SVM), flexible OFDM analysis (Opt. SVO), and AM/FM/PM Modulation and Audio Measurements (Opt. SVA). Wideband satellite and point-to-point microwave links can be directly observed with SignalVu analysis software.



General Purpose Digital Modulation Analysis (Opt. SVM) used to demodulating a 16QAM backhaul link running at 312.5 MS/s.

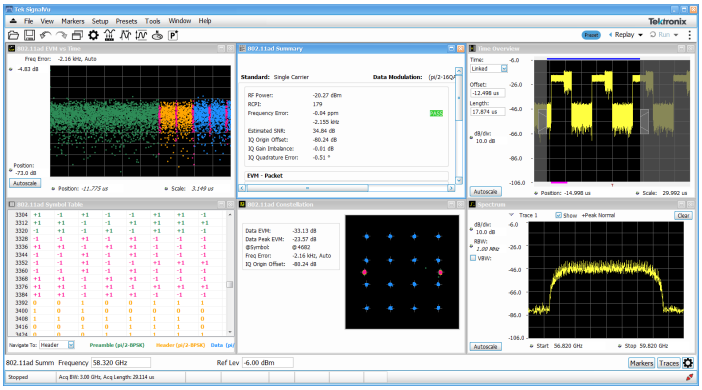
WiGig IEEE802.11ad/ay transmitter testing

Option SV30 provides comprehensive analysis for WiGig IEEE802.11ad/ay IC characterization. Used together with the DPO77002SX, it delivers the industry's most accurate signal quality measurement at 60 GHz. Automatically detect the packet Start, as well as decode packet information in the Header; synchronize to preamble using the Golay codes in the short training field; demodulates preamble, header, and payload separately; and measures EVM in each of these sections per the standard.

SV30 provides significant margin in EVM performance compared to what is required by the standard. Channel Impulse coefficients are also available. Both Control PHY (802.11ad) and Single Carrier PHY (802.11ad and 802.11ay) are supported and this option provides analysis of 802.11ay 2.16 GHz packets or 4.23 GHz adjacent 2-channel bonded packets.

Testing and verification can be done on IF and RF setups. RF power, Received Power Indicator (RCPI), Frequency error (Max, Average, Std. Deviation), DC Offset, IQ DC origin offset, IQ Gain and Phase imbalance, Signal Quality, and estimated SNR measurements are reported in the Summary display. Pass/Fail results are reported using customizable limits and the presets make the test set-up push-button.

For further insight into the signal, color coding is available in the user interface, allowing you to visualize the EVM spread across the analyzed packet with color codes differentiating regions. You can also view the demodulated symbols in tabular form with different color codes and with an option to traverse to the start of each region for easier navigation.



DPO770002SX with SV30 provides the industry's most accurate EVM. It allows easy setup to perform transmitter measurements including time overview of the bursts, spectrum, constellation diagram, decoded burst information, and EVM measurements.

Modulation formats	**802.11ad**: MCS0-12.6 **802.11ay**: MCS1-21
	802.11ad/ay Single carrier: π/2 BPSK, π/2 QPSK, π/2 16QAM, π/2 64QAM **802.11ad Control PHY**: π/2 DBPSK
Measurements	RF output power, Received Channel Power Indicator (RCPI), Estimated SNR, Frequency Error, Symbol Rate Error, IQ Origin Offset, IQ Phase Imbalance, IQ Gain Imbalance, IQ Quadrature Error, EVM results for each packet region (STF, CEF, Header and Data). Packet information includes the Packet type, Preamble, Synchronization Word or Access Code, Packet Header, Payload length, and CRC details.
Displays	Constellation, EVM vs Time, Symbol Table, Summary

Residual EVM, measured at RF (Channel 1-6) on DPO770002SX

For DPO770002SX, the measurement uncertainty is ± 0.3% due to pre-compensation filter and affects of the AWG70000 upconverter.

	802.11ad MCS0-12.6	802.11ay MCS1-21
Channel1-4	1.2 - 1.6% (-38.4 to -35.9 dBc)	1.2 - 1.6% (-38.4 to -35.9 dBc)
Channel 5-6	1.4 - 2.5% (-37.1 to -32.0 dBc)	1.4 - 2.5% (-37.1 to -32.0 dBc)
Channel 1-2, 2-3, 3-4 (adjacent bonded)	NA	1.2 - 1.7% (-38.4 to -35.4 dBc)
Channel 4-5, 5-6 (adjacent bonded)	NA	< 2.5% (< -32.0 dBc)

Table continued…

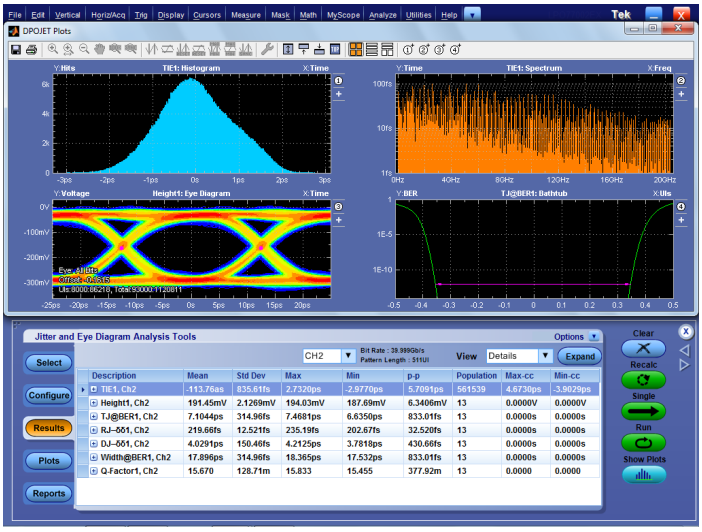
Advanced analysis

A full suite of Advanced Analysis applications are available for insight into specific signal and system behavior. These tools compliment an extensive range of features built into each DPO70000-series instrument to fully characterize performance of a device or system under test.

DPOJET Comprehensive Jitter and Noise Analysis

DPOJET provides engineers the highest measurement sensitivity and accuracy available in real-time instruments. With comprehensive jitter and eye-diagram analysis and decomposition algorithms DPOJET simplifies discovering signal integrity concerns and jitter and their related sources in today's high-speed serial, digital, and communication system designs.

To support measurement on signals acquired with the DPO7OE1 and DPO7OE2 optical probes, DPOJET now also provides optical measurements. These include Extinction Ratio (ER), Optical Modulation Amplitude (OMA), Optical High value, and Optical Low value.



DPOJET Jitter and Eye Diagram Analysis - Simplify identifying signal integrity issues, jitter, and their related sources.

Noise analysis with DPOJET (Opt. DJAN)

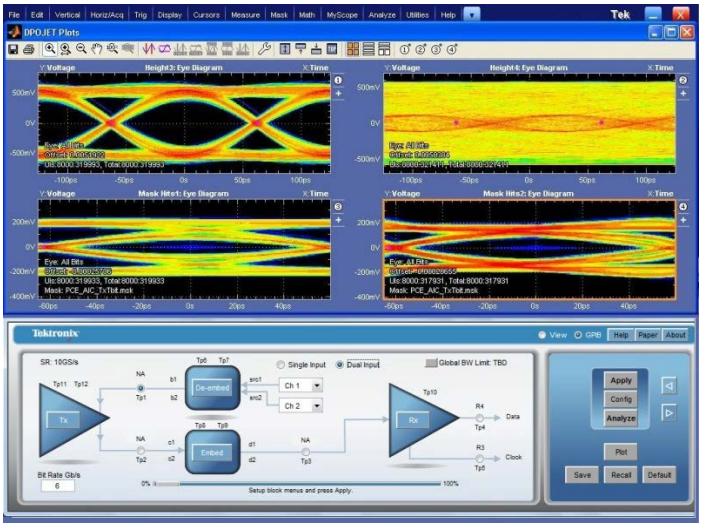
Option DJAN adds a comprehensive toolset for noise analysis to DPOJET. In the past, users have relied on jitter measurements and visualization alone to understand the behavior of their device under test. The test methodologies defined by many of the standard bodies have largely been concerned with the impact of jitter on horizontal eye closure. As data rates increase, the eye that is being analyzed has become smaller and smaller, making analysis of both vertical and horizontal eye closures a requirement. Understanding both the impact of jitter and noise enables engineers to predict the overall eye opening at a target bit error ratio.

Jitter essentials, advanced analysis and custom extensions

DPOJET Essentials is standard on the DPO70000SX Series with the DPOJET advanced version available as an option. Application-specific measurement packages are also available that extend DPOJET and perform the extensive set of tests required by industry standard groups.

SDLA signal path de-embed and custom filters

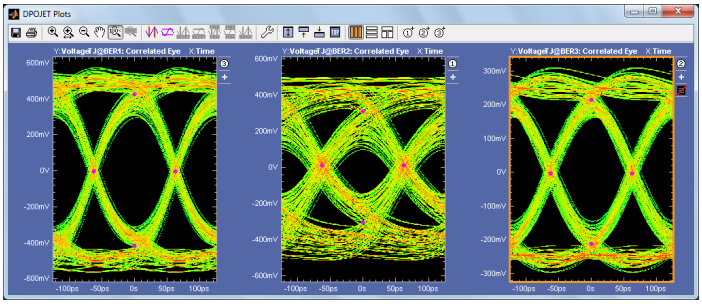
Acceleration of signaling speeds and shrinking geometries create several challenges for next generation multi-gigabit designs and test methodologies. Designs are evolving to address these challenges with advanced equalization techniques at the transmitter and receiver. Smaller form factors make signal access more difficult, resulting in non-ideal probing points. This can lead to loss and reflections on the acquired signal due to impedance discontinuities that are not present at the ideal measurement location. The advanced techniques employed by the designs call for advanced measurement solutions. The challenge begins with the signal acquisition; capturing a signal through cables, probes and fixtures distort the signal shape. SDLA Visualizer allows you to de-embed the effects (reflections, insertion loss, and cross coupling) of the measurement circuit (cables, probes, and fixtures) from the waveform while taking into account the transmitter output and receiver input impedance. De-embedding these effects improves the accuracy of measurements and can make the difference between passing or failing a test.



Signal path equalization

Using the optional Serial Data Link Analysis Visualizer (SDLA64) application, you can gain further insight into serial data links with the capability to emulate the serial data channel from its S-parameters, remove reflections, cross-coupling, and loss caused by fixtures, cables, or probes, and open closed eyes caused by channel effects using receiver equalization techniques, such as CTLE, DFE, FFE. IBIS-AMI models for silicon-specific receiver equalization can used to observe on-chip behavior.

The eye diagrams below illustrate the correlated eye of a signal before a channel, after a channel, and after equalization. Eye closure due to channel effects have effectively been removed using SDLA and in this case the eye widths are within ~3 ps as shown in the eye diagram on the left and right hand sides.

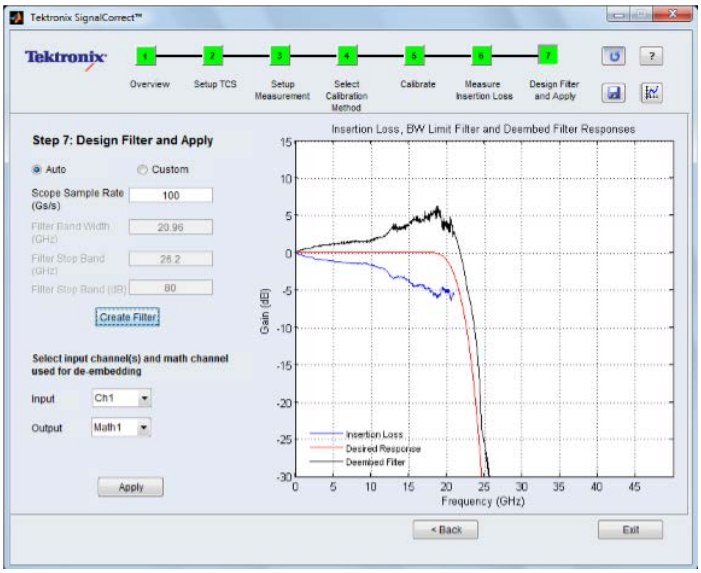


Custom filters

Create your own filters or use the filters provided standard with the DPO70000SX Series to enhance your ability to isolate or remove a component of your signal (noise or specific harmonics of the signal). These customizable FIR filters can be used to implement signal-processing techniques, such as removing signal pre-emphasis or minimizing the effects of fixtures and cables connected to the device under test.

SignalCorrect™ software and TCS70902 Calibration Source

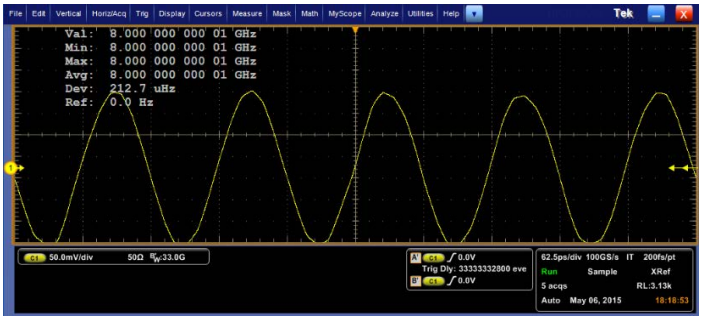
SignalCorrect allows quick characterization of cables, fixtures and other types of interconnects using the TCS70902 fast step source and the response captured on a DPO70000SX Series real-time oscilloscope.



SignalCorrect creates a filter that you can apply to your oscilloscope inputs to de-embed your device or interconnect under test.

Counter timer

The high resolution counter/timer is a new optional feature that is made possible by the new trigger system in the DPO70000SX series oscilloscopes. This is a precision frequency counter which provides frequency analysis up to 25 GHz, with up to 13 digits of resolution and 12 digits/second. Using the internal clock, this counter is accurate to better than 1 ppm. Higher accuracy is possible using a high precision external clock source. Because this measurement is made through the trigger system, it measures each and every cycle of the signal on a continuous basis during the trigger gate time, rather than making measurements on finite blocks of data through the normal acquisition channel.



This feature provides the ability to make highly accurate clock stability measurements. In the screen capture shown, a deviation of 212 µHz of source wander is measured on an 8 GHz precision source. In this figure, the signal generator was set to 8.00000000001 GHz, and the scope measured precisely that amount.

The timer allows precise measurements between trigger events with a 200 fs resolution, and can include time measurements from an A event to a B event, where A and B events can be any valid trigger mode (e.g. Glitch, Runt, Edge, etc). This feature is useful for measuring propagation delays, or analyzing anomaly occurrence rates.

Three important distinctions between this counter/timer and conventional counter/timers are:

- > 25 GHz analog bandwidth
- Wide selection of high bandwidth scope probes available for the highest signal fidelity connection to the DUT
- Ability to view the waveform on-screen to insure the counter/timer is seeing a valid waveform, and that trigger levels are set appropriately for the waveform

Built-in analysis system

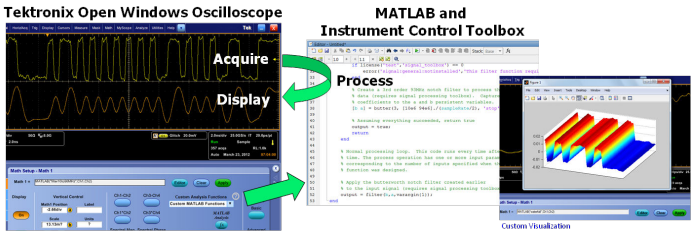
DPO70000SX includes a wide variety of built-in features for visualizing and measuring signal behaviors. Select from 54 automatic measurements using a graphical palette that logically organizes measurements into Amplitude, Time, Histogram, and Communications categories. Gather further insight into your measurement results with statistical data such as mean, min, max, standard deviation, and population.

Define and apply math expressions to waveform data for on-screen results in terms that you can use. Access common waveform math functions with the touch of a button. Or, for advanced applications, create algebraic expressions consisting of live waveforms, reference waveforms, math functions, measurement values, scalars, and user-adjustable variables with an easy-to-use calculator-style editor.

With deep acquisition memory, margin testing can be done over many cycles and long duration trends in the data can be observed. Plus, data from the oscilloscope can be captured into Microsoft Excel using the unique Excel toolbar, and formatted into custom reports using the Word toolbar provided with the DPO70000SX Series.

Custom math expressions with MATLAB

Tektronix custom math expressions with MATLAB enable users to create MATLAB scripts that process live waveform data and return results into scope math traces. Extensions can also use MATLAB features to create specialized analysis and visualizations.



Debugging

Throughout the design cycle, DPO70000SX Series oscilloscopes provide the ability to debug malfunctioning subsystems and isolate the cause. With the high waveform capture rate of FastAcq® you can quickly identify signal anomalies that occur intermittently - saving minutes, hours, or even days by quickly revealing the nature of faults so sophisticated trigger modes can be applied to isolate them. Using Pinpoint® triggers, infrequent events such as glitches or signal runts caused by bus contention or signal integrity issues can be captured, analyzed, and then eliminated.

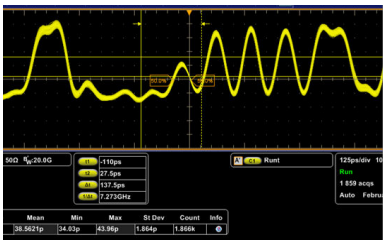
FastAcq® expedites debugging by clearly showing imperfections

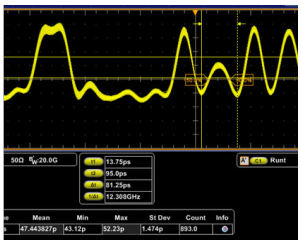
More than just color grading or event scanning, the FastAcq proprietary DPX® acquisition technology captures signals at more than 300,000 waveforms per second on all TekConnect® channels [2] simultaneously, dramatically increasing the probability of discovering infrequent fault events. And with a simple turn of the intensity knob you can clearly "see a world others don't see", displaying the complete picture of your circuit's operation. Some oscilloscope vendors claim high waveform capture rates for short bursts of time, but only DPO70000 Series oscilloscopes, enabled by DPX technology, can deliver these fast waveform capture rates on a sustained basis.

Pinpoint® trigger

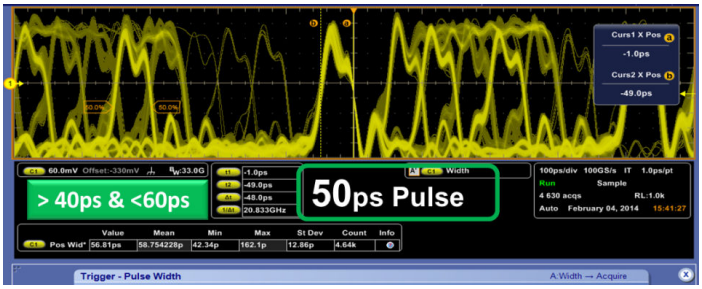
Whether you're trying to find a problem signal or need to isolate a section of a complex signal for further analysis, Tektronix Pinpoint triggering provides the solution. Pinpoint triggering allows selection of virtually all trigger types on both A and B trigger events delivering the full suite of advanced trigger types for finding sequential trigger events. Pinpoint triggers provide trigger reset capabilities that begin the trigger sequence again after a specified time, state, or transition so that even events in the most complex signals can be captured.

The DPO70000SX Series provides the highest trigger system performance available in a real time scope. The figure shows triggering on <50 ps bit-wide runt pulses (fails to cross both thresholds within specified time) on 25.78 GBaud (100GbE) signaling. High system bandwidth and extreme trigger timer precision enable reliable capture of signal aberrations and efficient isolation of fault conditions.

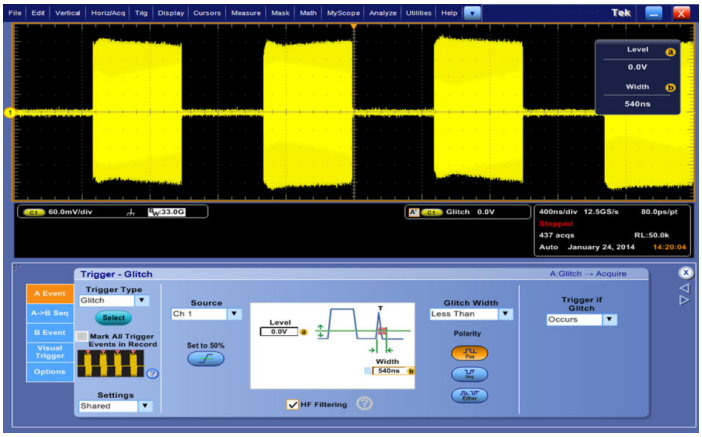




In the next figure, pulse width discrimination is used to isolate pulses >40 ps and <60 ps wide, showing reliable capture of 50 ps pulses within a 20 Gbps PRBS11 sequence.



DPO70000SX includes a unique Envelope trigger mode that enables direct triggering on the envelope of a modulated carrier. Edge, Width and Timeout trigger types can be applied to a detected envelope to provide stable trigger on modulated bursts or discriminate bursts of a specific width. Carrier frequency can range from 500 MHz to 20 GHz to address a broad range of applications. The figure illustrates triggering on burst of specific width.



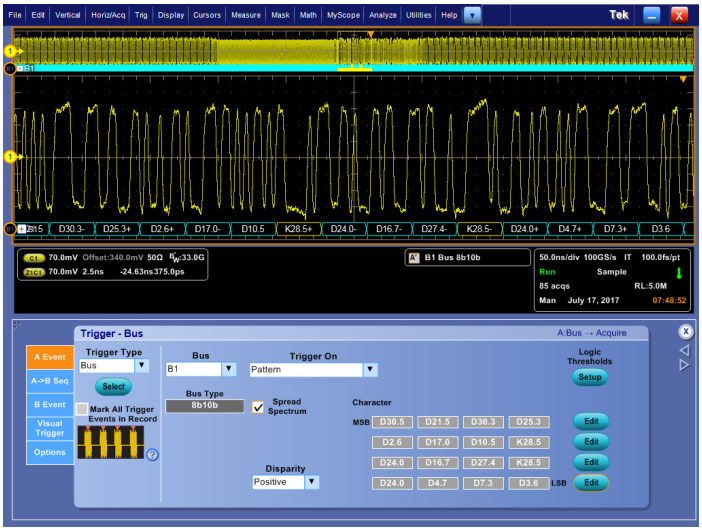
Hardware serial pattern triggering

To verify serial architectures, the DPO70000SX Series offers two different serial pattern trigger and decode options with built-in clock recovery, enabling the ability to correlate events across physical and link layers. The instrument can recover the embedded clock signal, identify transitions, and allow you to set the desired encoded words for a specific serial pattern trigger to be captured. These features can be enabled on the DPO70000SX Series with two options. Option ST14G provides serial trigger performance from 600 Mbps to 14.1 Gbps and bit level or character level trigger and decode of 8b/10b NRZ serial data streams. Option SR-6466 enables support for 64b/66b NRZ serial trigger and decode and requires ST14G. Any active TekConnect input channel can be used as a source for the hardware serial trigger options.

The 160 bit (16 character) pattern match feature applies to generic NRZ serial patterns and 8b/10b. It enables the oscilloscope to reliably trigger on a specific section of a serial data sequence, thereby facilitating diagnostic and debug work by isolating portions of the serial data stream. For 64b/66b specific patterns, the option enables trigger on a valid or invalid sync header, control block, data block, and up to 132 bit pattern match (on 2 adjacent 64b/66b blocks).

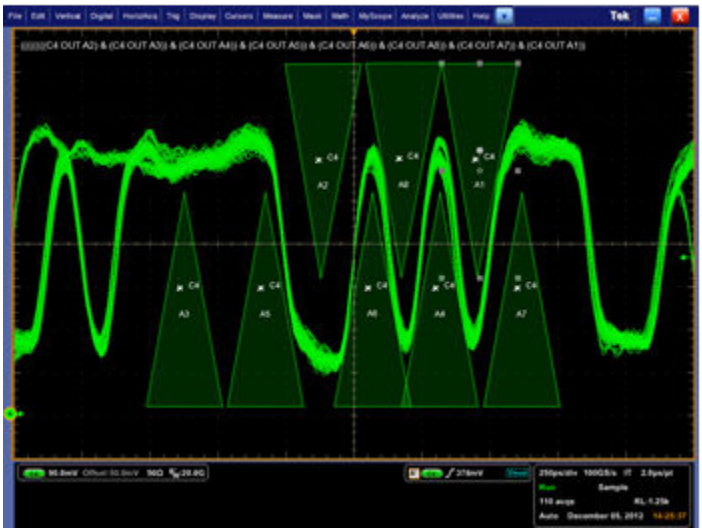
In addition, the hardware serial trigger feature is designed for reliable operation even in the presence of spread spectrum clocks with a range of 0-5000 pps downspread.

2 FastAcq not available on ATI channels.



Visual trigger

Visual Trigger further extends the Pinpoint Triggering's capabilities, adding another level of trigger qualification to find important events in a wide variety of complex signals. Visual Trigger qualifies Pinpoint triggers by scanning through all waveform acquisitions and comparing them to on-screen areas (geometric shapes). Up to eight areas can be created using a mouse or touchscreen, and a variety of shapes (triangles, rectangles, hexagons, or trapezoids) can be used to specify the desired trigger behavior. Once shapes are created, they can be edited interactively to create ideal trigger conditions



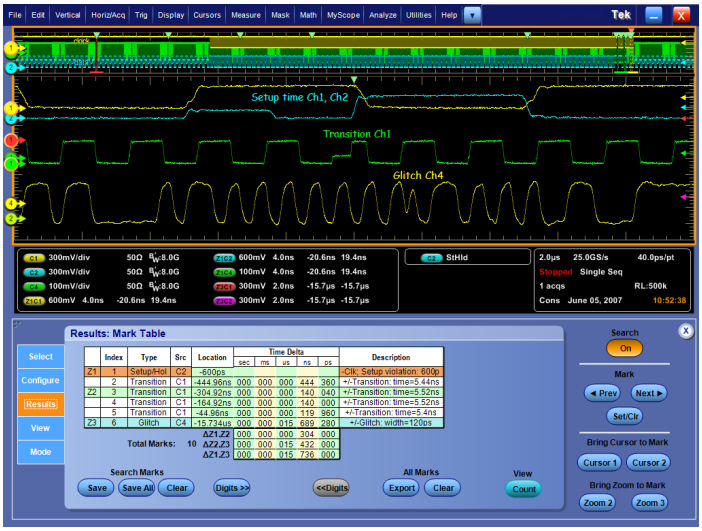
FastFrame™

When the key events you are interested in are widely spaced in time, such as bursts of activity on a bus, the FastFrame segmented memory feature on the DPO70000SX Series enables you to capture the events of interest while conserving acquisition memory. Using multiple trigger events, FastFrame captures and stores short bursts of signals and saves them as frames for later viewing and analysis. Capturing thousands of frames is possible, so long-term trends and changes in the bursting signal can be analyzed. FastFrame also minimizes trigger re-arm time, allowing for acquisition of events that are very closely spaced in time. Using this feature, it is possible to reliably acquire signals that are spaced by only a few microseconds.

Extended features that are part of FastFrame include the ability to very efficiently calculate a point-point average of all frames to a single waveform (summary frame). In addition, it is possible to perform an orthogonal average, whereby multiple sets of frames can be acquired. In this mode, each #1 frame is averaged on a point-by-point basis with all other #1 frames, each #2 frame is averaged on a point-by-point basis with all other #2 frames, and so on up to the total number of frames specified. This feature provides a very efficient way to extend the dynamic range of the oscilloscope while acquiring repeatable sequences of events.

Advanced search and mark

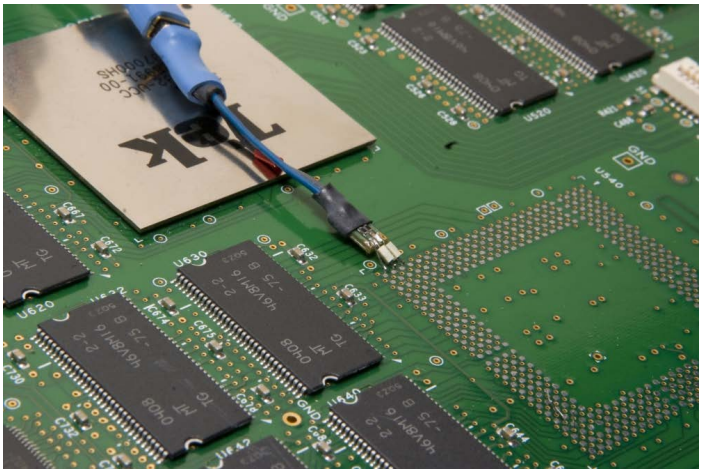
Isolating the key event causing your system failure can often be a tedious task. With the Advanced Event Search and Mark feature standard on the DPO70000SX Series, examining data and highlighting important events, skipping the unimportant ones, and enhancing the comprehension of event relationships is made easy. With ASM, you'll be able to navigate through long record length acquisitions effortlessly and quickly locate the event you have been trying to find. Advanced searches can be defined individually or using the scope's trigger settings as the definition for the search. Even Visual Trigger areas can be used as part of the ASM criteria.



Advanced Search and Mark - Highlights important events and provides convenient previous and next buttons and mouse clicks to navigate between events of interest effortlessly

Probing and remote-head coaxial input

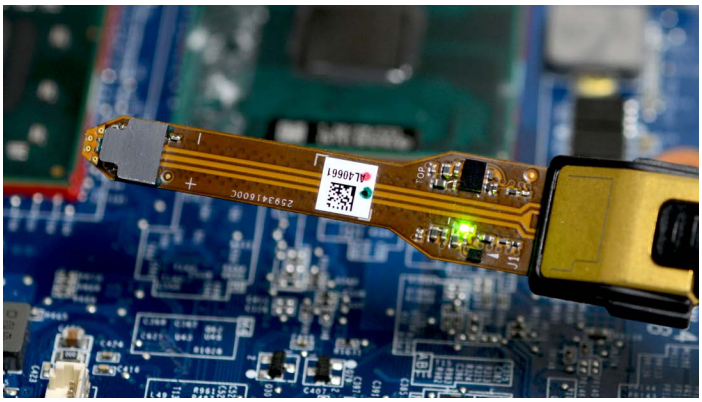
Often the biggest challenge in debugging a system is getting access to the required signals. Tektronix offers a wide array of probing solutions, including the P7700, P7600, and P7500 TriMode™ probing system with bandwidths that are perfectly matched to the DPO70000SX Series. The P7700, P7600, and P7500 TriMode probes allow you to switch among differential, single ended, and common-mode measurements without moving the probe from its connection points. The P7600 Series combines low noise, 33 GHz bandwidth and the convenience of Trimode probing. The P7500 Series offers probes with performance from 4 GHz to 25 GHz and offers several low-cost solder tips with quick connection features that allow moving the probe to various solder points fast and easy.



The low-cost solder tips available for the P7500 TriMode probes allow quick connection so moving the probe to various solder points is fast and easy.

P7700 Series TriMode Probes

The P7700 Series TriMode probes provide the highest probe fidelity available for real-time oscilloscopes. In addition, with connectivity innovations such as solder down tips with the probe's input buffer mounted only a few millimeters from the end of the tip, the P7700 Series probes provide unmatched usability for connecting to today's most challenging electronic designs.



P77STFLXA solder down, flex circuit accessory with an active buffer amplifier on its tip provides up to 20 GHz bandwidth.

DPO7OE series optical probes

The DPO7OE series optical probes can be used as an optical reference receiver for high speed serial data signals (using selectable Bessel-Thomson ORR filters), or can be used as a conventional O/E converter for general wide-bandwidth optical signal acquisition. The DPO7OE series is compatible with DPO/MSO70000 C/DX/SX models. Connected to TekConnect channels provides up to 33 GHz bandwidth. Connected to ATI channels, the DPO7OE1 provides up to 42 GHz electrical response; the DPO7OE2 provides up to 59 GHz electrical bandwidth response.

DPO7OE1 33 GHz optical probe

Signal acquisition

ATI input

The DPO77002SX 70 GHz ATI input channel uses industry-standard 1.85 mm coaxial connection system specified to 67 GHz, with typical performance to 70 GHz. The instrument includes a calibration-grade 1.85 mm female-female adapter installed in the ATI input connector (male) to provide mechanical protection and gender selection. Instruments also include a static protection wrist strap, torque wrench and a set of backing wrenches to facilitate proper care and installation of signal path elements, ensuring optimal measurement performance. The 1.85 mm connection system is compatible with 2.4 mm (50 GHz) elements.

TekConnect® inputs

DPO70000SX models include the TekConnect signal interconnect system, offering unparalleled versatility with a wide array of accessory signal access and conditioning solutions. The TCA292D TekConnect adapter provides 2.92 mm connection, 50 Ω coaxial environment to 33 GHz.

High performance Auxiliary Trigger input

DPO70000SX includes an Auxiliary Trigger input (TekConnect) suitable for high performance Edge triggering without consuming an acquisition channel. Aux trigger bandwidth is >10 GHz on the DPO70000SX Series with <1.5 ps_{RMS} jitter.

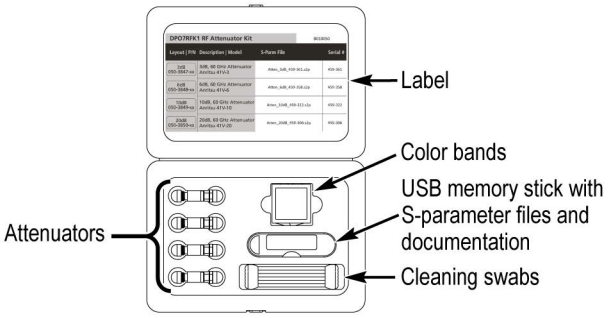
Channel timing deskew

All DPO70000SX models include differential fast-edge outputs matched to <1.6 ps on the front panel that provide a convenient source for aligning channel timing in a coaxial environment. Instruments include accessories to accomplish channel-to-channel timing deskew using the built-in source. Additional accessories can be purchased separately to accomplish even finer time alignment or deskew in a probe-based environment

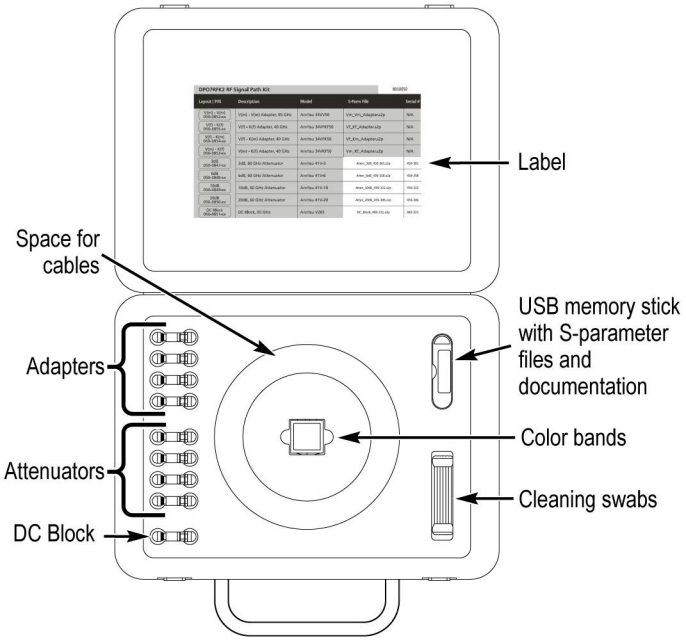
DPO7RF Signal Path Solutions

The DPO7RF Signal Path Solutions kits provide you with preconfigured kits of components you can use to optimize measurement performance in your ultra-high bandwidth applications. Kits include attenuators, adapters, DC Blocks, power divider, cleaning swabs, color marking bands, S-parameters and documentation.

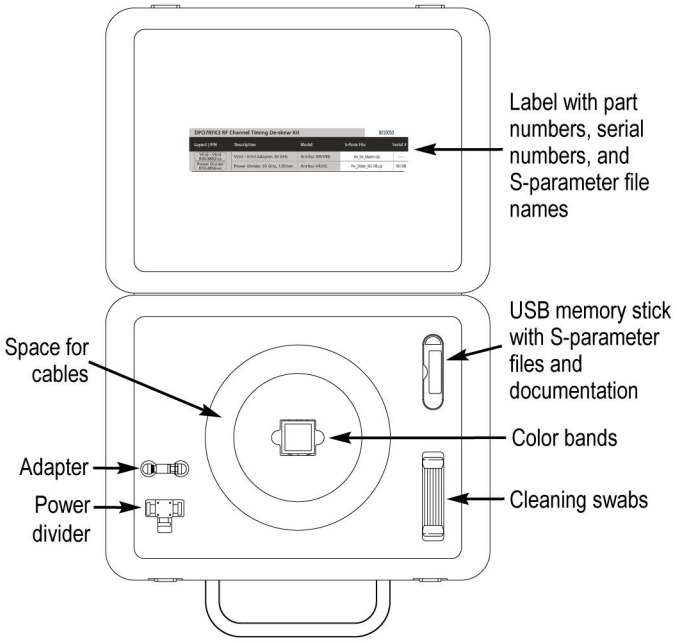
- Kits and cables include S-parameter files and documentation on a USB memory stick
- Kits include signal path marking accessories
- Kits include cleaning swabs for proper maintenance of sensitive RF components



DPO7RFK1-1.85 mm characterized attenuator kit.



DPO7RFK2-Extended 1.85 mm characterized attenuator/adapter kit.



DPO7RFK3-1.85 mm deskew kit.

Bench or rack mount

DPO70000SX models are equally suited for bench and rack-mounted use and complimented with a number of elements to address specific environments.

UltraSync cables are available in 1 meter and 2 meter lengths to enable configuration flexibility. The default 1 meter cable is suitable for typical two- and four-unit configurations with uniformly stacked instruments. The longer cable enables combinations operating at 90° to one another or face-to-face around a DUT. Cable length can be mixed in a configuration to suit application need and time de-skewed as a system to provide precise channel-to-channel time alignment.

Instrument cases include recesses that align with feet such that stacked units mechanically engage one another for added stability. This feature also works in inverted-stacking configurations and mixed stacks that include an OM4000 Optical Receiver. Models include threaded holes for user-provided side brackets in cases where specific combinations are to be "locked" together.

DPO70000SX units may even be operated inverted if desired, to shorten OMA receiver connection distance as shown.

Rack environment

The DPO70000SX rack mount is a tray directly attached to the instrument. The tray occupies 1U rack height in addition to the 3U instrument and preserves a cooling channel for the unit. The rack mount also provides heavy-duty carry handles for transporting the instrument outside the rack environment.

The rack-mounting kit allows units to be mounted upright or inverted to minimize input cable length, just as when stacking on a bench.

The DPO70000SX rack-mount tray can also house a front-mounted Solid State Drive (SSD) for easy access to instrument mass storage in a rack environment.

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

Model overview

	DPO77002SX/DPS77004SX		DPO75902SX/DPS75904SX		DPO75002SX/DPS75004SX	
	ATI channel	**TekConnect channels**	**ATI channel**	**TekConnect channels**	**ATI channel**	**TekConnect channels**
Analog channels/bandwidth	DPO77002SX 1 ch/67 GHz 1 ch/70 GHz (typical) DPS77004SX 2 ch/67 GHz 2 ch/70 GHz (typical)	DPO77002SX 2 ch/33 GHz DPS77004SX 4 ch/33 GHz	DPO75902SX 1 ch/59 GHz DPS75904SX 2 ch/59 GHz	DPO75902SX 2 ch/33 GHz DPS75904SX 4 ch/33 GHz	DPO75002SX 1 ch/50 GHz DPS75004SX 2 ch/50 GHz	DPO75002SX 2 ch/33 GHz DPS75004SX 4 ch/33 GHz
Sample rate per channel	200 GS/s	100 GS/s	200 GS/s	100 GS/s	200 GS/s	100 GS/s
Rise time (typical)	10% to 90%: 5.6 ps 20% to 80%: 4.3 ps	10% to 90%: 13 ps 20% to 80%: 9 ps	10% to 90%: 6.8 ps 20% to 80%: 5.2 ps	10% to 90%: 13 ps 20% to 80%: 9 ps	10% to 90%: 7.8 ps 20% to 80%: 6 ps	10% to 90%: 13 ps 20% to 80%: 9 ps
Vertical Noise (% of full scale), BWE on, max sample rate (typical)	0.83% of full scale @ 0 V offset (300 mV_{FS})	0.71% of full scale @ 0 V offset (500 mV_{FS})	0.77% of full scale @ 0 V offset (300 mV_{FS})	0.71% of full scale @ 0 V offset (500 mV_{FS})	0.69% of full scale @ 0 V offset (300 mV_{FS})	0.71% of full scale @ 0 V offset (500 mV_{FS})
Record length, points (each channel, standard)	62.5 M	62.5 M	62.5 M	62.5 M	62.5 M	62.5 M
Record length (each channel, Opt. 10XL)	125 M	125 M	125 M	125 M	125 M	125 M
Record length (each channel, Opt. 20XL)	250 M	250 M	250 M	250 M	250 M	250 M
Record length (each channel, Opt. 50XL)	1 G	1 G	1 G	1 G	1 G	1 G
Timing resolution	5 ps (200 GS/s)	10 ps (100 GS/s)	5 ps (200 GS/s)	10 ps (100 GS/s)	5 ps (200 GS/s)	10 ps (100 GS/s)
Duration at highest sample rate (Standard)	313 µs	625 µs	313 µs	625 µs	313 µs	625 µs
Duration at highest sample rate (Opt. 10XL)	625 µs	1.25 ms	625 µs	1.25 ms	625 µs	1.25 ms
Duration at highest sample rate (Opt. 20XL)	1.25 ms	2.5 ms	1.25 ms	2.5 ms	1.25 ms	2.5 ms
Duration at highest sample rate (Opt. 50XL)	5.0 ms	10 ms	5.0 ms	10 ms	5.0 ms	10 ms

	DPO77002SX		DPS77004SX		DPO73304SX	DPS73308SX
	Single unit		Dual-unit system		Single unit	Dual-unit system
	ATI channel	TekConnect channels	ATI channel	TekConnect channels	TekConnect channels	TekConnect channels
Analog channels/bandwidth	1/70 GHz (typical) 1/67 GHz	2/33 GHz	2/70 GHz (typical) 2/67 GHz	4/33 GHz	2/33 GHz, 4/23 GHz	4/33 GHz, 8/23 GHz
Sample rate per channel	200 GS/s	100 GS/s	200 GS/s	100 GS/s	2 ch 100 GS/s, 4 ch 50 GS/s	4 ch 100 GS/s, 8 ch 50 GS/s
Rise time (typical)	10% to 90%: 5.6 ps 20% to 80%: 4.3 ps	10% to 90%: 13 ps 20% to 80%: 9 ps	10% to 90%: 5.6 ps 20% to 80%: 4.3 ps	10% to 90%: 13 ps 20% to 80%: 9 ps	10% to 90%: 13 ps 20% to 80%: 9 ps	10% to 90%: 13 ps 20% to 80%: 9 ps
Vertical Noise (% of full scale), BWE on, max sample rate (typical)	0.83% of full scale @ 0 V offset (300 mV_{FS})	0.71% of full scale @ 0 V offset (500 mV_{FS})	0.83% of full scale @ 0 V offset (300 mV_{FS})	0.71% of full scale @ 0 V offset (500 mV_{FS})	0.71% of full scale @ 0V offset (500 mV_{FS})	0.71% of full scale @ 0 V offset (500 mV_{FS})
Record length, points (each channel, standard)	62.5 M	62.5 M	62.5 M	62.5 M	62.5 M	62.5 M
Record length (each channel, Opt. 10XL)	125 M	125 M	125 M	125 M	125 M	125 M
Record length (each channel, Opt. 20XL)	250 M	250 M	250 M	250 M	250 M	250 M
Record length (each channel, Opt. 50XL)	1 G	1 G	1 G	1 G	1 G on 2 ch, 500 M on 4 ch	1 G on 2 ch each unit, 500 M on 4 ch each unit
Timing resolution	5 ps (200 GS/s)	10 ps (100 GS/s)	5 ps (200 GS/s)	10 ps (100 GS/s)	10 ps (100 GS/s)	10 ps (100 GS/s)
Duration at highest sample rate (Standard)	313 µs	625 µs	313 µs	625 µs	625 µs	625 µs
Duration at highest sample rate (Opt. 10XL)	625 µs	1.25 ms	625 µs	1.25 ms	1.25 ms	1.25 ms
Duration at highest sample rate (Opt. 20XL)	1.25 ms	2.5 ms	1.25 ms	2.5 ms	2.5 ms	2.5 ms
Duration at highest sample rate (Opt. 50XL)	5.0 ms	10 ms	5.0 ms	10 ms	10 ms	10 ms

	DPO73304SX/ DPS73308SX	DPO72504SX	DPO72304SX	DPO72004SX	DPO71604SX	DPO71304SX
	TekConnect channels	TekConnect channels	TekConnect channels	TekConnect channels	TekConnect channels	TekConnect channels
Analog channels/bandwidth	DPO73304SX 2 ch/33 GHz, 4 ch/23 GHz DPS73308SX 4 ch/33 GHz, 8 ch/23 GHz	2 ch/25 GHz, 4 ch/23 GHz	4 ch/23 GHz	4 ch/20 GHz	4 ch/16 GHz	4 ch/13 GHz

Table continued…

	DPO73304SX/ DPS73308SX	DPO72504SX	DPO72304SX	DPO72004SX	DPO71604SX	DPO71304SX
	TekConnect channels	TekConnect channels	TekConnect channels	TekConnect channels	TekConnect channels	TekConnect channels
Sample rate per channel	DPO73304SX 2 ch 100 GS/s, 4 ch 50 GS/s DPS73308SX 4 ch 100 GS/s, 8 ch 4 50 GS/s	2 ch 100 GS/s, 4ch 50 GS/s	2 ch 100 GS/s, 4 ch 50 GS/s	2 ch 100 GS/s, 4ch 50 GS/s	2 ch 100 GS/s, 4 ch 50 GS/s	2 ch 100 GS/s, 4 ch 50 GS/s
Rise time (typical)	10% to 90%: 13 ps 20% to 80%: 9 ps	10% to 90%: 16 ps 20% to 80%: 12 ps	10% to 90%: 17 ps 20% to 80%: 13 ps	10% to 90%: 22 ps 20% to 80%: 15 ps	10% to 90%: 26 ps 20% to 80%: 19 ps	10% to 90%: 32 ps 20% to 80%: 23 ps
Vertical Noise (% of full scale), BWE on, max sample rate (typical)	0.71% of full scale @ 0 V offset (500 mVFS)	0.63% of full scale @ 0 V offset (500 mVFS)	0.53% of full scale @ 0 V offset (500 mVFS)	0.51% of full scale @ 0 V offset (500 mVFS)	0.43% of full scale @ 0 V offset (500 mVFS)	0.44% of full scale @ 0 V offset (500 mVFS)
Record length, points (each channel, standard)	62.5 M	62.5 M	62.5 M	62.5 M	62.5 M	62.5 M
Record length (each channel, Opt. 10XL)	125 M	125 M	125 M	125 M	125 M	125 M
Record length (each channel, Opt. 20XL)	250 M	250 M	250 M	250 M	250 M	250 M
Record length (each channel, Opt. 50XL)	DPO73304SX 1 G on 2 ch, 500 M on 4 ch DPS73308SX 1 G on 2 ch each unit, 500 M on 4 ch each unit	1 G on 2 ch, 500 M on 4 ch	1 G on 2 ch, 500 M on 4 ch	1 G on 2 ch, 500 M on 4 ch	1 G on 2 ch, 500 M on 4 ch	1 G on 2 ch, 500 M on 4 ch
Timing resolution	10 ps (100 GS/s)	10 ps (100 GS/s)	10 ps (100 GS/s)	10 ps (100 GS/s)	10 ps (100 GS/s)	10 ps (100 GS/s)
Duration at highest sample rate (Standard)	625 µs	625 µs	625 µs	625 µs	625 µs	625 µs
Duration at highest sample rate (Opt. 10XL)	1.25 ms	1.25 ms	1.25 ms	1.25 ms	1.25 ms	1.25 ms
Duration at highest sample rate (Opt. 20XL)	2.5 ms	2.5 ms	2.5 ms	2.5 ms	2.5 ms	2.5 ms
Duration at highest sample rate (Opt. 50XL)	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms

Vertical system - analog channels

Input coupling

TekConnect channels: Two modes: DC, 50 ohms to a programmable termination voltage; Ground.

The termination can be connected to a DC voltage:

≤ 1.2 V_{FS} settings: -3.5 V to 3.5 V,

	> 1.2 V_{FS} settings: 0.0 V
ATI channel:	DC, 50 Ω.

Input resistance

≤1.2 V_{FS} settings	50 Ω ±3% at 18 to 28 ºC (64 to 82 ºF)
	50 Ω ±4% over 5 to 45 ºC (45 to 113 ºF)
>1.2 V_{FS} settings	50 Ω ±4.4% over 5 to 45 ºC (45 to 113 ºF)
ATI channel	50 Ω ±3% from 18 °C to 28 °C
	50 Ω ±4% from 5 °C to 45 °C

Sensitivity range

TekConnect channels	62.5 mV_{FS} to 6 V_{FS}
ATI channel	100 mV_{FS} to 300 mV_{FS}.

Maximum input voltage

TekConnect channels:	≤1.2 V_{FS} settings:
	±1.5 V relative to the termination bias (30 mA maximum)
	±5 V absolute maximum input
	>1.2 V_{FS} settings:
	±8 V. Limited by maximum Vterm current and the attenuator power rating at maximum temperature.
ATI channel:	±0.75 V_{pk}
Aux channel:	±5.0 V_{pk}

Input termination voltage (VTerm) range, TekConnect channels

≤1.2 V_{FS} settings:	-3.5 V to +3.5 V
>1.2 V_{FS} settings:	0 V

Frequency response tolerance

All modes, BWE on, 18 ºC to 28 ºC (typical)	To determine the amount of performance derating above the temperature limit, use the Typical Temperature Variation table
TekConnect channel:	Step settings TekConnect channels: 77.5 mV_{FS}, 151 mV_{FS}, 302 mV_{FS}, 605 mV_{FS}, 1210 mV_{FS}., 1620 mV_{FS}, 3240 mV_{FS}
	±0.5 dB from DC to 50% of nominal BW
	±1.5 dB from 50% to 80% of nominal BW
	All other gain settings:
	±1.0 dB from DC to 50% of nominal BW
	±2.0 dB from 50% to 80% of nominal BW

ATI channel:

All volts/div settings

±0.5 dB from DC to 20 GHz

±0.75 dB from >20 GHz to 30 GHz

±1.25 dB from >30 GHz to 68.5 GHz

±2 dB from >68.5 GHz to 69.5 GHz

+2 / -3 dB at 70 GHz

TekConnect channel

Typical temperature derating			
Frequency	**TC, (dB/°C)**	**5 °C**	**45 °C**
DC - 5 GHz	0.005 dB/°C	0.07	-0.09
10 GHz	0.010 dB/°C	0.13	-0.17
15 GHz	0.025 dB/°C	0.33	-0.43
20 GHz	0.045 dB/°C	0.59	-0.77
23 GHz	0.10 dB/°C	1.30	-1.70
25 GHz	0.10 dB/°C	1.30	-1.70
30 GHz	0.115 dB/°C	1.50	-1.96
33 GHz	0.160 dB/°C	2.08	-2.72

ATI channel

Typical temperature derating			
Frequency	**TC, (dB/°C)**		
DC - 5 GHz	0.005 dB/°C		
DC - 10 GHz	0.002 dB/°C		
15 GHz	0.005 dB/°C		
20 GHz	0.01 dB/°C		
30 GHz	0.05 dB/°C		
40 GHz	0.07 dB/°C		
50 GHz	0.05 dB/°C		
60 GHz	0.05 dB/°C		

Bandwidth limit

Depending on instrument model: 70 GHz to 1 GHz in 1 GHz steps, or 500 MHz; 5 GHz steps above 35 GHz Hardware-only bandwidth settings at 33 GHz available on non-ATI channels. No hardware-only settings available on ATI channel.

Vertical resolution

8 bits, (11 bits with averaging)

Number of digitized bits

8 bits

✓ DC gain accuracy

± 2%

Effective number of bits (typical). Average value from DC to full bandwidth of model.

70 GHz ATI Channel	4.6 bits at 250 mV FS, 200 GS/s
59 GHz ATI Channel	4.8 bits at 250 mV FS, 200 GS/s

Table continued…

50 GHz ATI Channel	5.0 bits at 250 mV FS, 200 GS/s
33 GHz TekConnect Channels	5.0 bits at 500 mV FS, 100 GS/s
25 GHz TekConnect Channels	5.2 bits at 500 mV FS, 100 GS/s
23 GHz TekConnect Channels	5.4 bits at 500 mV FS, 100 GS/s
20 GHz TekConnect Channels	5.5 bits at 500 mV FS, 100 GS/s
16 GHz TekConnect Channels	5.8 bits at 500 mV FS, 100 GS/s
13 GHz TekConnect Channels	5.9 bits at 500 mV FS, 100 GS/s

Effective bits, typical.

The following charts give the typical effective bits for a 225 mV p-p sine-wave input sampled at 250 mV_{FS} and maximum sample rate.

	DPO77002SX	DPO75902SX	DPO75002SX
Input Frequency	200 GS/s, 70 GHz	200 GS/s, 59 GHz	200 GS/s, 50 GHz
10 MHz	5.0 bits	5.14 bits	5.22 bits
0.92 GHz	5.0 bits	5.13 bits	5.21 bits
1.92 GHz	5.0 bits	5.13 bits	5.21 bits
2.92 GHz	5.0 bits	5.14 bits	5.22 bits
3.92 GHz	5.0 bits	5.13 bits	5.21 bits
4.92 GHz	4.9 bits	5.03 bits	5.11 bits
5.92 GHz	4.9 bits	5.03 bits	5.10 bits
6.92 GHz	4.9 bits	5.03 bits	5.10 bits
7.92 GHz	4.9 bits	5.02 bits	5.08 bits
8.92 GHz	4.9 bits	5.03 bits	5.09 bits
9.92 GHz	4.9 bits	5.03 bits	5.09 bits
10.92 GHz	4.9 bits	5.03 bits	5.10 bits
11.92 GHz	4.9 bits	5.06 bits	5.13 bits
12.92 GHz	4.9 bits	5.05 bits	5.17 bits
13.92 GHz	4.9 bits	5.07 bits	5.19 bits
14.92 GHz	4.9 bits	5.10 bits	5.21 bits
15.92 GHz	4.8 bits	4.98 bits	5.11 bits
16.92 GHz	4.8 bits	4.89 bits	5.06 bits
17.92 GHz	4.7 bits	4.79 bits	4.95 bits
18.92 GHz	4.7 bits	4.79 bits	4.95 bits
19.92 GHz	4.7 bits	4.80 bits	4.93 bits
20.92 GHz	4.7 bits	4.80 bits	4.92 bits
21.92 GHz	4.6 bits	4.74 bits	4.82 bits
22.92 GHz	4.6 bits	4.77 bits	4.85 bits
23.92 GHz	4.7 bits	4.81 bits	4.87 bits
24.92 GHz	4.6 bits	4.74 bits	4.79 bits
25.92 GHz	4.6 bits	4.73 bits	4.92 bits
26.92 GHz	4.5 bits	4.76 bits	4.93 bits

Table continued…

	DPO77002SX	DPO75902SX	DPO75002SX
27.92 GHz	4.5 bits	4.70 bits	4.91 bits
28.92 GHz	4.5 bits	4.70 bits	4.95 bits
29.92 GHz	4.5 bits	4.85 bits	4.95 bits
30.92 GHz	4.5 bits	4.75 bits	4.90 bits
31.92 GHz	4.5 bits	4.70 bits	4.80 bits
32.92 GHz	4.4 bits	4.59 bits	4.75 bits
33.92 GHz	4.4 bits	4.70 bits	4.79 bits
35.92 GHz	4.5 bits	4.60 bits	4.67 bits
37.92 GHz	4.3 bits	4.40 bits	4.47 bits
39.92 GHz	4.3 bits	4.57 bits	4.65 bits
41.92 GHz	4.2 bits	4.49 bits	4.62 bits
43.92 GHz	4.3 bits	4.70 bits	4.87 bits
45.92 GHz	4.1 bits	4.16 bits	4.71 bits
47.92 GHz	4.0 bits	4.10 bits	4.64 bits
49.92 GHz	4.0 bits	4.10 bits	4.15 bits
51.92 GHz	4.1 bits	4.18 bits	
53.92 GHz	4.1 bits	4.18 bits	
55.92 GHz	4.2 bits	4.30 bits	
57.92 GHz	4.5 bits	4.60 bits	
59.92 GHz	4.8 bits		
61.92 GHz	4.8 bits		
63.92 GHz	4.9 bits		
65.92 GHz	4.9 bits		
67.92 GHz	4.9 bits		
69.92 GHz	4.7 bits		

BWE on, Enhanced MIMO filter, full bandwidth

	DPO77002SX, DPO75902SX, DPO75002SX, DPO73304SX TekConnect channels		DPO72504SX		DPO72304SX	
Input frequency	100 GS/s, 33 GHz	50 GS/s, 23 GHz	100 GS/s, 25 GHz	50 GS/s, 23 GHz	100 GS/s, 23 GHz	50 GS/s, 23 GHz
10 MHz	5.4 bits	5.4 bits	5.5 bits	5.3 bits	5.9 bits	5.3 bits
1 GHz	5.2 bits	5.3 bits	5.4 bits	5.3 bits	5.8 bits	5.2 bits
2 GHz	5.2 bits	5.2 bits	5.3 bits	5.1 bits	5.7 bits	5.2 bits
3 GHz	5.1 bits	5.1 bits	5.2 bits	5.1 bits	5.6 bits	5.1 bits
4 GHz	5.1 bits	5.2 bits	5.1 bits	5.1 bits	5.6 bits	5.2 bits
5 GHz	5.2 bits	5.1 bits	5.2 bits	5.2 bits	5.6 bits	5.1 bits
6 GHz	5.0 bits	5.1 bits	5.1 bits	5.2 bits	5.6 bits	5.0 bits
7 GHz	5.0 bits	5.1 bits	5.2 bits	5.2 bits	5.5 bits	5.1 bits

Table continued…

	DPO77002SX, DPO75902SX, DPO75002SX, DPO73304SX TekConnect channels		DPO72504SX		DPO72304SX	
8 GHz	5.1 bits	5.1 bits	5.2 bits	5.2 bits	5.6 bits	5.1 bits
9 GHz	5.1 bits	5.0 bits	5.3 bits	5.2 bits	5.6 bits	5.0 bits
10 GHz	5.2 bits	5.1 bits	5.2 bits	5.1 bits	5.5 bits	5.0 bits
11 GHz	5.1 bits	4.9 bits	5.4 bits	5.1 bits	5.4 bits	4.9 bits
12 GHz	5.2 bits	5.0 bits	5.4 bits	5.2 bits	5.5 bits	5.0 bits
13 GHz	5.1 bits	4.9 bits	5.4 bits	5.0 bits	5.4 bits	4.9 bits
14 GHz	5.1 bits	4.9 bits	5.4 bits	5.0 bits	5.3 bits	4.8 bits
15 GHz	4.9 bits	4.8 bits	5.3 bits	5.0 bits	5.1 bits	4.8 bits
16 GHz	4.8 bits	4.8 bits	5.2 bits	5.0 bits	5.2 bits	4.7 bits
17 GHz	4.9 bits	4.8 bits	5.2 bits	5.0 bits	5.2 bits	4.7 bits
18 GHz	4.9 bits	4.8 bits	5.2 bits	5.1 bits	5.3 bits	4.8 bits
19 GHz	4.8 bits	4.8 bits	5.1 bits	5.0 bits	5.2 bits	4.7 bits
20 GHz	4.7 bits	4.6 bits	4.9 bits	5.0 bits	5.1 bits	4.7 bits
21 GHz	4.8 bits	4.8 bits	4.8 bits	4.8 bits	5.3 bits	4.8 bits
22 GHz	4.8 bits	4.9 bits	4.8 bits	4.8 bits	5.3 bits	4.8 bits
23 GHz	4.9 bits		4.9 bits		5.2 bits	
24 GHz	5.0 bits		4.9 bits			
25 GHz	4.8 bits		4.9 bits			
26 GHz	4.9 bits					
27 GHz	4.8 bits					
28 GHz	4.7 bits					
29 GHz	4.9 bits					
30 GHz	4.9 bits					
31 GHz	4.8 bits					
32 GHz	4.8 bits					
33 GHz	4.8 bits					

	DPO72004SX		DPO71604SX		DPO71304SX	
Input frequency	100 GS/s, 20 GHz	50 GS/s, 20 GHz	100 GS/s, 16 GHz	50 GS/s, 16 GHz	100 GS/s 13 GHz 50 GS/s 13 GHz	
10 MHz	5.7 bits	5.4 bits	6.0 bits	5.7 bits	6.0 bits	5.7 bits
1 GHz	5.7 bits	5.4 bits	5.9 bits	5.6 bits	6.1 bits	5.8 bits
2 GHz	5.4 bits	5.1 bits	5.9 bits	5.6 bits	6.0 bits	5.7 bits
3 GHz	5.5 bits	5.2 bits	5.7 bits	5.4 bits	5.7 bits	5.5 bits
4 GHz	5.5 bits	5.2 bits	5.7 bits	5.4 bits	5.8 bits	5.6 bits
5 GHz	5.5 bits	5.2 bits	5.6 bits	5.4 bits	5.9 bits	5.6 bits
6 GHz	5.5 bits	5.2 bits	5.7 bits	5.5 bits	5.8 bits	5.6 bits
7 GHz	5.6 bits	5.2 bits	5.7 bits	5.5 bits	5.9 bits	5.6 bits

Table continued…

	DPO72004SX		DPO71604SX		DPO71304SX	
8 GHz	5.6 bits	5.2 bits	5.8 bits	5.5 bits	5.9 bits	5.6 bits
9 GHz	5.6 bits	5.2 bits	5.8 bits	5.5 bits	5.9 bits	5.6 bits
10 GHz	5.5 bits	5.2 bits	5.8 bits	5.5 bits	5.9 bits	5.6 bits
11 GHz	5.5 bits	5.2 bits	5.8 bits	5.4 bits	5.9 bits	5.6 bits
12 GHz	5.5 bits	5.2 bits	5.8 bits	5.4 bits	5.8 bits	5.6 bits
13 GHz	5.5 bits	5.0 bits	5.8 bits	5.4 bits	5.9 bits	
14 GHz	5.5 bits	5.0 bits	5.8 bits	5.4 bits		
15 GHz	5.5 bits	5.0 bits	5.8 bits	5.4 bits		
16 GHz	5.5 bits	4.9 bits	5.8 bits	5.4 bits		
17 GHz	5.5 bits	4.9 bits				
18 GHz	5.5 bits	5.0 bits				
19 GHz	5.5 bits	4.9 bits				
20 GHz	5.4 bits	4.9 bits				
21 GHz						
22 GHz						
23 GHz						
24 GHz						
25 GHz						
26 GHz						
27 GHz						
28 GHz						
29 GHz						
30 GHz						
31 GHz						
32 GHz						
33 GHz						

Offset range

TekConnect channels

Full Scale voltage range	Offset range
62.5 mV_{FS} – 1.2 V_{FS}	±3.4 V
>1.2 V_{FS} – 6 V_{FS}	±6 V

ATI channel

Full Scale voltage range	Offset range
100 mV_{FS} – 300 mV_{FS}	±300 mV - (10 div × Volts/div)

Offset accuracy

Net offset = offset - (position × volts/division).

Full scale voltage range	Offset accuracy
62.5 mV_{FS} to 1.2 V_{FS} (TekConnect channels)	±(0.4% | net offset | + 0.2% | net offset – Vterm setting | + 2.5 mV + 1% FS)
>1.2 V_{FS} to 6 V_{FS} (TekConnect channels)	±(0.6% | net offset | + 13.4 mV + 1% FS)
100 mV_{FS} to 300 mV_{FS} (ATI channel)	±(0.35% | net offset | + 2 mV + 1% FS)

Position range

± 5 divisions

Channel-to-channel crosstalk (channel isolation), typical

Input frequency range (up to the rated bandwidth). Assumes two channels with the same scale and bandwidth settings. The limits apply up to the bandwidth of the particular instrument.

ATI models		
Specified channels	**Instrument frequency range**	**Isolation**
ATI channels (isolation between any two [or more] ATI channels in separate units), requires UltraSync	DC to 70 GHz	70 dB
TekConnect channels in an ATI unit (isolation between channels 1 and 3)	DC to 33 GHz	60 dB
TekConnect channels to ATI channel (isolation between channels 1 and 3 to channel 2)	DC to 4 GHz	55 dB
	>4 GHz to 10 GHz	45 dB
	>10 GHz to 20 GHz	35 dB
	>20 GHz to 30 GHz	30 dB
	>30 GHz to 33 GHz	27 dB
ATI channel to TekConnect (non-ATI) channels (isolation between channel 2 and channels 1 or 3)	DC to 3 GHz	55 dB
	>3 GHz to 12 GHz	40 dB
	>12 GHz to 33 GHz	30 dB
	>33 to 70 GHz	60 dB

TekConnect models (non-ATI)		
Specified channels	**Instrument frequency range**	**Isolation**
Isolation between channels 1 or 2 and channels 3 or 4	DC to 33 GHz	60 dB
Isolation between channels 1 and 2, or channels 3 and 4	DC to 2 GHz	60 dB
	>2 to 10 GHz	42 dB
	>10 to 20 GHz	35 dB
	>20 to 33 GHz	30 dB

Displayed Average Noise Level (DANL) (typical)

6.25 mV/div (10 mV/div for ATI channel)

500 kHz span, 1 kHz RBW

Peak detector, averaged trace, input terminated

DC-500 MHz	≤ -145 dBm/Hz	29 dB NF
500 MHz - 20 GHz	≤ -155 dBm/Hz	19 dB NF
20 GHz - 70 GHz	≤ -150 dBm/Hz	24 dB NF

Signal to noise dynamic range (typical)

TekConnect channel

3 dBm input @ 1 GHz, 100 mV/div CF 1 GHz, 50 MHz span, 1 kHz RBW, +20 MHz from center	-102 dB

ATI channel

-7.5 dBm input @ 65 GHz, 30 mV/div CF 65 GHz, 50 MHz span, 1 kHz RBW, +20 MHz from center	-95 dB

Phase noise (typical)

30 mV/div, input signal 90% full scale

	10 kHz	**100 kHz**	**1 MHz**	**10 MHz**
1 GHz	-113 dBc/Hz	-120 dBc/Hz	-133 dBc/Hz	-139 dBc/Hz
12.5 GHz	-95 dBc/Hz	-98 dBc/Hz	-127 dBc/Hz	-139 dBc/Hz
40 GHz	-86 dBc/Hz	-89 dBc/Hz	-110 dBc/Hz	-132 dBc/Hz
60 GHz	-82 dBc/Hz	-87 dBc/Hz	-110 dBc/Hz	-125 dBc/Hz

$2^{nd}/3^{rd}$ harmonic distortion

6.25 mV/div (10 mV/div for ATI channel)

Input signal -26 dBm (-22 dBm for ATI channel)

TekConnect channel

Fundamental	**2^{nd}**	**3^{rd}**
1 GHz	≤ -60 dBc	≤ -55 dBc
500 MHz - 10 GHz	≤ -55 dBc	≤ -50 dBc
10 GHz -16.5 GHz	≤ -45 dBc	≤ -50 dBc

ATI channel

1 GHz	≤ -60 dBc	≤ -50 dBc
500 MHz - 10 GHz	≤ -60 dBc	≤ -45 dBc
10 GHz - 25 GHz	≤ -50 dBc	≤ -50 dBc

Table continued…

25 GHz - 35 GHz	≤ -40 dBc	≤ -50 dBc

2 Tone 3rd order intermodulation intercept TOI (typical)

TekConnect channel

200 mV/div, 3 dBm input/tone 2.598 GHz and 2.602 GHz 20 MHz span, 100 kHz RBW	+30 dBm

ATI channel

30 mV/div, -15 dBm input/tone 64.998 GHz and 65.002 GHz 20 MHz span 100 kHz RBW	+10 dBm

2 Tone 3rd order intermodulation distortion (typical)

6.25 mV/div (10 mV/div for ATI CH)

-34 dBm input/tone (-29 dBm input/tone for ATI channel)

10 MHz separation, 50 MHz span, 100 kHz RBW

TekConnect 10 MHz - 33 GHz	≤ -45 dBc
ATI channel 10 MHz - 65 GHz	≤ -40 dBc

SFDR (typical)

TekConnect channel CF 2.5 GHz, span 5 GHz, 100 kHz RBW, 50 mV/div Input -8 dBm @ 1 GHz	≤ -65 dBc
ATI channel CF 65 GHz, span 6 GHz, 100 kHz RBW, 30 mV/div Input -12 dBm @ any frequency from 62 GHz - 68 GHz	≤ -55 dBc

Other spurious responses (typical)

6.25 mV/div (10 mV/div for ATI channel)

Input signal -26 dBm (-22 dBm for ATI channel)

After SPC, EENOB enabled

Interleave image (all channels)

Spur freq. = N(12.5 GHz) +-Fin, N from 1 to 5	≤ -40dBc

ATI channel image

Spur freq. = 37.5 GHz + Fin for Fin DC-37.5 GHz 37.5 GHz - Fin for Fin 37.5 GHz to 70 GHz	≤ -30dBc

Residual responses

With input terminated

6.25 mV/div (10 mV/div for ATI channel)

After SPC, EENOB enabled

TekConnect channel	≤ -75 dBm
Exceptions at 12.5 GHz and 25 GHz	≤ -60 dBm
ATI channel	≤ -75 dBm
Exceptions at 12.5 GHz, 25 GHz, 37.5 GHz, and 50 GHz	≤ -60 dBm

Input VSWR (typical)

TekConnect channel ≤ 1.2 Vfs settings

DC - 17 GHz	1.4:1
17 GH - 20 GHz	1.6:1
20 GHz - 33 GHz	2.0:1

TekConnect channel >1.2 Vfs settings

DC - 17 GHz	1.4:1
17 GHz - 33 GHz	2.0:1

ATI channel

DC - 20 GHz	1.5:1
20 GHz - 33 GHz	1.8:1
33 GHz - 70 GHz	2.6:1

Horizontal system

Time base accuracy

±0.8 x 10^{-6} (within 1st year), ±0.3 x 10^{-6} aging/year after first year when operated within 23° C ±5° C after 30 minute warm-up.

Typical: ±0.1 x 10^{-6} initial accuracy after adjustment.

Time base delay time range

–5.0 ks to 1.0 ks

Sample Clock Jitter (typical)

ATI channel	<10 µs Duration: <65 fs_{RMS} <500 µs Duration: <100 fs_{RMS} (Internal and External Stable only)
TekConnect channel	<10 µs Duration: <100 fs_{RMS}

Jitter noise floor (typical)

N_{TYP} = typical input-referred noise spec $(volts\ rms)_{RMS}$

F_N = 1.3 for instrument bandwidth ≤ 9GHz; 1.5 for instrument bandwidth ≥ 10GHz.

SR = slew rate around the measurement

$F_I = 1.7 \times 10^{-2}/sqrt(2) = 1.2 \times 10^{-2}$

t_r = rise time of the measurement edge

t_j = timebase jitter or aperture uncertainty

$$JNF_{rms} = \sqrt{\left(N_{typ} \times F_N\right)^2 \times \left[\left(\frac{1}{SR}\right)^2\right] + F_I^{\,2} \times t_r^{\,2} + \left(t_j\right)^2}$$

The interpolated sample rate of the waveform must be at least 25 times the bandwidth of the signal being measured.

Trigger jitter (typical) 10 fs using enhanced trigger placement.

Trigger jitter DC coupled A edge (typical) 10 fs using enhanced trigger placement.

1.3 ps rms for low frequency, fast rise time signal, A edge, holdoff time = 30 µs

Time/Div settings

Automatic mode	10 ps/div to 1000 S/div
ATI channel (only sample rate is 200 GS/s)	Max RT setting: 500 µs/div (with 1G RL, 50XL option) Min RT setting: 25 ps/div Max IT setting: 250 µs/div (with 1G RL, 50XL option) Min IT setting: 500 fs/div
TekConnect channels [3] (at max sample rate of 100 GS/s)	Max RT setting: 1 ms/div (with 1G RL, 50XL option) Min RT setting: 50 ps/div Max IT setting: 10 µs/div (with 1G RL, 50XL option) Min IT setting: 500 fs/div

Delay between channels, BWE (typical) ≤ 500 fs between any two channels within the same box at any gain setting at 25 °C ±5 °C prior to any user adjustment. Manual adjustment available with 10 fs minimum resolution. Derate linearly to ≤ 1.5 ps at 5 °C and 45 °C.

Channel skew stability, UltraSync (typical) ≤ 250 fs_{RMS} between any two channels between instruments at any gain setting at 25 °C ±5 °C. Derate linearly to ≤ 3 ps at 5 °C and 45 °C.

[3] Sample rate on TekConnect channels can be varied down to 3.125 samples/second, resulting in a max RT setting of 6.55 Ms/div, with a record length of 205 M (requires 250 M or higher RL, 20XL option)

Channel-to-Channel deskew range ±75 ns

Acquisition system

Acquisition modes

Sample	Acquires and displays sampled values
Average	From 2 to 10,000 waveforms can be included in an average waveform
Envelope	From 1 to 2×10^9 waveforms included in min-max envelope
Hi-Res	Real-time boxcar averaging reduces random noise and increases resolution
Peak detect	Capture and display narrow glitches at all real-time sampling rates. Glitch widths: 1 ns at ≤125 MS/s; 1/sample rate at ≥250 MS/s
FastAcq® (TekConnect channels only)	FastAcq® optimizes the instrument for analysis of dynamic signals and capture of infrequent events, capturing >300,000 waveforms per second on all TekConnect channels simultaneously, standalone configuration only
FastFrame™	Acquisition memory divided into segments; maximum trigger rate >310,000 waveforms per second. Time of arrival recorded with each event. Frame finder tool helps to visually identify transients. Available for both ATI and TekConnect channels, for all system configurations including stand-alone and multi-unit stacks using UltraSync.
Roll mode	Scrolls sequential waveform points across the display in a right-to-left rolling motion. Works at sample rates up to 10 MS/s with a maximum record length of 40 MS. TekConnect channels only, standalone configuration only
Waveform database	Accumulates waveform data providing a three-dimensional array of amplitude, time, and counts. TekConnect channels only, standalone configuration only

Pinpoint® Trigger system

Trigger sensitivity (typical)

Internal DC coupled

A-Event trigger, B-Event trigger	≤ 5%FS from DC to 50 MHz ≤ 7.5%FS at 5 GHz ≤ 10%FS at 10 GHz ≤ 15%FS at 15 GHz ≤ 35%FS at 20 GHz ≤ 50%FS at 25 GHz

Aux input 50 Ω (external trigger)

Auxiliary input	100 mV_{pp} from DC to 1 GHz 175 mV_{pp} at 4 GHz 225 mV_{pp} at 8 GHz 325 mV_{pp} at 10 GHz 800 mV_{pp} at 12 GHz

Edge trigger sensitivity DC coupled (typical)

All sources, positive or negative edge.

Trigger Source	Sensitivity
A-Event trigger	≤ 5%FS from DC to 50 MHz ≤ 7.5%FS at 5 GHz ≤ 10%FS at 10 GHz ≤ 15%FS at 15 GHz ≤ 35%FS at 20 GHz ≤ 50%FS at 25 GHz
B-Event trigger	≤ 5%FS from DC to 50 MHz ≤ 7.5%FS at 5 GHz ≤ 10%FS at 10 GHz ≤ 15%FS at 15 GHz ≤ 35%FS at 20GHz ≤ 50%FS at 25 GHz
Auxiliary input	100 mV_{pp} from DC to 1 GHz 175 mV_{pp} at 4 GHz 225 mV_{pp} at 8 GHz 450 mV_{pp} at 10 GHz 800 mV_{pp} at 11 GHz

Edge trigger sensitivity, non-DC-coupled modes (typical)

All sources, positive or negative edge, for vertical scale settings ≥10 mV/div and ≤1 V/div

Trigger Coupling	Sensitivity
NOISE REJ	15%FS from DC to 50 MHz 22.5% at 5 GHz 30%FS at 10 GHz 45%FS at 15 GHz 100%FS at 20 GHz
AC	Same as DC-coupled limits for frequencies > 100 Hz, attenuates signals <100 Hz
HF REJ	Same as DC-coupled limits for frequencies < 20 kHz, attenuates signals > 20 kHz
LF REJ	Same as DC-coupled limits for frequencies > 200 kHz, attenuates signals < 200 kHz

Table continued…

Trigger Coupling	Sensitivity
RF	Minimum hysteresis / High sensitivity
	A TRIG TekConnect 2.5% FS from DC to 50 MHz 2.5% FS at 5 GHz 2.5% FS at 10 GHz 5% FS at 15 GHz 7.5% FS at 20 GHz 12.5% FS at 25 GHz
	B TRIG TekConnect 2.5% FS from DC to 50 MHz 2.5% FS at 5 GHz 2.5% FS at 10 GHz 5% FS at 15 GHz 7.5% FS at 20 GHz 20% FS at 25 GHz
	A TRIG ATI 2.5% FS from DC to 50 MHz 2.5% FS at 5 GHz 2.5% FS at 10 GHz 5% FS at 15 GHz 10% FS at 20 GHz 22.5% FS at 25 GHz
	B TRIG ATI 2.5% FS from DC to 50 MHz 2.5% FS at 5 GHz 2.5% FS at 10 GHz 5% FS at 15 GHz 10% FS at 20 GHz 22.5% FS at 25 GHz

A-Event and delayed B-Event trigger types

Standalone instrument	DPO73304SX DPO72504SX DPO72304SX DPO72004SX DPO71604SX DPO71304SX	DPO77002SX DPO75902SX DPO75002SX	
Trigger type	**TekConnect channel**	**ATI channel**	**TekConnect channel**
Edge	X	X	X
Glitch	X	X	X
Width	X	X	X
Runt	X	X	X
Serial (8b10b)	X	X	X
Window	X	X	X
Timeout	X	X	X
Period/Frequency	X	X	X
Envelope	X	X	X
Transition	X	X	X
Logic Pattern	X		X
Setup/Hold	X		X
Logic state	X		

Multi-unit configuration	DPO73304SX DPO72504SX DPO72304SX DPO72004SX DPO71604SX DPO71304SX	DPO77002SX DPO75902SX DPO75002SX	
Trigger type	**TekConnect channel**	**ATI channel**	**TekConnect channel**
Edge	X	X	X
Glitch	X	X	X

Table continued…

Multi-unit configuration	DPO73304SX DPO72504SX DPO72304SX DPO72004SX DPO71604SX DPO71304SX	DPO77002SX DPO75902SX DPO75002SX	
Trigger type	**TekConnect channel**	**ATI channel**	**TekConnect channel**
Width	X	X	X

Main trigger modes

Auto, Normal, and Single

Trigger sequences

Main, Delayed by Time, Delayed by Events, Reset by Time, Reset by State, Reset by Transition. All sequences can include a separate horizontal delay after the trigger event to position the acquisition window in time

Trigger coupling

DC, AC (attenuates <100 Hz)

HF Rej (attenuates >20 kHz)

LF Rej (attenuates <200 kHz)

Noise Reject (reduces sensitivity)

RF coupling (increases trigger sensitivity and bandwidth at the highest operating frequencies)

Variable A-Event trigger holdoff range

250 ns to 12 s + random holdoff

Trigger level or threshold range

Trigger Source	Range
Ch1, 2, 3, or 4	Full scale
Auxiliary input	±3.65 V
Line	0 V, Not settable

Enhanced triggering

Enhanced triggering corrects the difference in timing between the trigger path and the acquired data path (supports all Pinpoint trigger types on both A- and B-Events except pattern trigger); Default On (user-selectable); Not available in FastAcq mode.

Line trigger

Trigger on power line signal. Level fixed at 0 V.

Serial pattern trigger

All 70000SX models. Requires Option ST14G

Visual Trigger

Requires Option VET

Max number of areas	8
Area shapes	Rectangle, Triangle, Trapezoid, Hexagon, user defined shapes (can have >40 vertices)
Compatibility	Visual Trigger qualification is compatible with all trigger types and all trigger sequences

Trigger types

Trigger types	Description
8b/10b	Trigger on 8b/10b buses, up to 160 bits.
64b/66b	Trigger on 64b/66b buses, up to 132 bits.
I^2C	Trigger on Start, Repeated Start, Stop, Missing ACK, Address (7 or 10 bit), Data, or Address and Data.
SPI	Trigger on SS or data.
PCIe	Trigger on PCIe buses.
USB	Trigger on USB buses.
CAN	Trigger on Start of Frame, Frame Type, Identifier, Data, End of Frame, Missing Ack, Bit Stuff Error.
LIN	Trigger on Sync, Identifier, Data, Ident and Data, Wakeup Frame, Sleep Frame, Error.
FlexRay	Trigger on Start of Frame, Indicator Bits, Cycle Count, Header Fields, Identifier, Data, End of Frame, Error.
RS-232/422/485/UART	Trigger on Start Bit, End of Packet, Data, and Parity Error.
MIL-STD-1553	Trigger on MIL-STD-1553 buses.
10/100BASE-T Ethernet	Trigger on 10/100BASE-T Ethernet buses.
Edge	Positive or negative slope on any channel or front-panel auxiliary input. Coupling includes DC, AC, noise reject, HF reject, LF reject, and RF coupling.
Frequency/Period	Trigger on event that crosses threshold twice with same slope within or outside of selectable time limits. Slope may be positive, negative or either.
Glitch	Trigger on or reject glitches of positive, negative, or either polarity. Minimum glitch width is 40 ps (typical) with rearm time of 50 ps (<5 ns interval), 75 ps above 5 ns.
Pattern	Trigger when pattern goes false or stays true for specified period of time. Pattern (AND, OR, NAND, NOR) specified for four input channels.
Runt	Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Event can be time- or logic-qualified. Minimum runt width is 40 ps (typical) with rearm time of 50 ps
Serial Trigger (8b10b)	Trigger on 8b10b encoded data and generic NRZ serial data, up to 160 bits
Setup/Hold	Trigger on violations of both setup time and hold time between clock and data present on any two input channels.

Table continued…

Trigger types	Description
State	Any logical pattern of channels (1, 2, 3) clocked by edge on channel 4. Trigger on rising or falling clock edge.
Timeout	Trigger on an event which remains high, low, or either, for a specified time period. Selectable from 300 ps.
Transition	Trigger on pulse edge rates Trigger on an event which remains high, low, or either, for a specified time period. Selectable from 300 ps. that are faster or slower than specified. Slope may be positive, negative, or either.
Width	Trigger on width of positive or negative pulse either within or out of selectable time limits (down to 40 ps).
Window	Trigger on an event that enters or exits a window defined by two user-adjustable thresholds. Event can be time or logic qualified.
Visual Trigger	Trigger when the Visual Trigger expression is satisfied.
Envelope	Qualification applied to Edge, Glitch, Width or Runt trigger such that trigger type is performed on the detected envelope of a modulated carrier. Carrier frequency 250 MHz to 15 GHz. Minimum burst width <20 ns, maximum gap between bursts <20 ns.

Trigger modes

Trigger mode	Description
Trigger Delay by Events	1 to 2 billion events.
Trigger Delay by Time	3.2 ns to 3 million seconds.
B-Event Scan	B-Event Scan is an A to B trigger sequence that will trigger and capture burst event data of interest as defined in the B-Event Scan setup menu. Captured bits can be scanned in a sequential or randomized fashion, and alternatively the trigger can toggle between two successive B trigger events. Eye diagrams can be constructed with burst data acquired as a result of scanning B-Event.
Arm A, Trig B	Arm on A, Trig on B allows for a single A arming event followed by one or more B trigger events. When combined with FastFrame, allows for very tight acquisition timing control.

Waveform analysis

Search and Mark Events

Search for edges, glitches, or pulses of specified width. Any events found matching the search criteria are marked and placed in the Event table. The search can use positive/negative slopes or both on any channels.

When an event of interest is found, other similar events can be found using "Mark All Trigger Events in Record" in the Pinpoint trigger control windows.

The Event table summarizes all found events. All events are time stamped in reference to trigger position. Users can choose to stop acquisitions when an event is found.

Waveform measurements

Automatic measurements	54, of which 8 can be displayed on-screen at any one time; measurement statistics, user-definable reference levels, measurement within gates isolating the specific occurrence within an acquisition to measure The DPOJET Jitter and Eye Analysis application offers additional automated and advanced measurements such as jitter.
Amplitude related	Amplitude, High, Low, Maximum, Minimum, Peak-to-Peak, Mean, Cycle Mean, RMS, Cycle RMS, Positive Overshoot, Negative Overshoot
Time related	Rise Time, Fall Time, Positive Width, Negative Width, Positive Duty Cycle, Negative Duty Cycle, Period, Frequency, Delay
Combination	Area, Cycle Area, Phase, Burst Width
Histogram related	Waveform Count, Hits in Box, Peak Hits, Median, Maximum, Minimum, Peak-to-Peak, Mean (μ), Standard Deviation (sigma), μ +1sigma, μ +2sigma, μ +3sigma

Waveform processing/math

Algebraic expressions	Define extensive algebraic expressions including Waveforms, Scalars, User-adjustable Variables, and Results of Parametric Measurements e.g. (Integral (CH1 – Mean(CH1)) × 1.414 × VAR1)
Arithmetic	Add, Subtract, Multiply, Divide Waveforms and Scalars
Filtering function	User-definable filters. Users specify a file containing the coefficients of the filter. Several example filter files are provided
Frequency domain functions	Spectral Magnitude and Phase, Real and Imaginary Spectra
Mask function	Generates a Waveform Database pixel map from a sample waveform. Sample count can be defined
Math functions	Average, Invert, Integrate, Differentiate, Square Root, Exponential, Log 10, Log e, Abs, Ceiling, Floor, Min, Max, Sin, Cos, Tan, ASin, ACos, ATan, Sinh, Cosh, Tanh
Relational	Boolean result of comparison >, <, ≥, ≤, ==, !=
Vertical units	Magnitude: Linear, dB, dBm Phase: Degrees, radians, group delay IRE and mV units
Window functions	Rectangular, Hamming, Hanning, Kaiser-Bessel, Blackman-Harris, Gaussian, Flattop2, Tek Exponential
Customized Functions using Math Plug-in Interface	An interface is provided to allow users to create their own custom math functions in MATLAB or Visual Studio

Display system

Color palettes	Normal, Green, Gray, Temperature, Spectral, and User-defined
Format	YT, XY, XYZ
Display resolution	1024 horizontal × 768 vertical pixels (XGA)
Display type	6.5 in. liquid-crystal active-matrix color display with capacitive touch screen
Horizontal divisions	10
Vertical divisions	10
Waveform styles	Vectors, Dots, Variable Persistence, Infinite Persistence

Computer system and peripherals

Operating system	Microsoft Windows 10 Enterprise IoT Edition
CPU	Intel Core I7-4790S, 3.2 GHz, Quad Core
System memory	32 GB
Solid state drive	Removable, ≥900 GB capacity

Input-output ports

Auxiliary trigger input characteristics and range	50 Ω, ±5 V (DC plus peak AC)
Auxiliary output logic polarity and functionality	Default output is A trigger low true (a negative edge when the A trigger event occurs). You can also program the output to A trigger high true, and B trigger low or high true.
Fast Edge output step amplitude and offset	1200 mV differential into a 100 Ω load with a -300 mV common mode.
External reference input frequency	10 MHz, 100 MHz, 12.5 GHz The instrument scans for either 10 MHz or 100 MHz. 12.5 GHz supported on separate SMA input.
12.5 GHz Clock In	1.3 V_{p-p} (6 dBm)
B, C, D 12.5 GHz Clock Out (UltraSync)	1.3 V_{p-p} (6 dBm)

Internal reference output voltage (typical)

10 MHz Vout pk-pk	> 800 mV peak-peak into 50 Ω > 1.6 V peak-peak into 1 MΩ (internally AC coupled).

Input and output ports

DVI-D Video port	A female Digital Visual Interface (DVI-D) compatible port
VGA port	A female Video Graphics Array (VGA) compatible port
DisplayPort	Two connectors (primary, secondary) provide digital display interfaces
PCIe	PCIe ports to configure multi-instrument systems
Trigger	UltraSync trigger bus
Keyboard and Mouse ports	PS-2 compatible, instrument must be powered down to make connection
LAN ports	Two RJ-45 connectors (LAN1, LAN2), support 10BASE-T, 100BASE-TX, and Gigabit Ethernet
External audio ports	External audio jacks for microphone input and line output
USB ports	Four front panel USB 2.0 connectors

Four rear panel USB 3.0/USB 2.0 connectors

One rear panel USB device connector

Data storage specifications

Nonvolatile memory retention time (typical) >20 years

Solid state drive

Waveforms and setups are stored on the solid state drive.

Solid state drive is a ≥900 GB solid state drive (removable).

Power source

Power consumption

<980 W, single instrument, maximum

≤780 W, single unit (typical)

Source voltage and frequency

100 V to 240 V_{RMS}, 50/60 Hz

115 V ±10%, 400 Hz

CAT II

Mechanical specifications

Dimensions

DPO70000SX models

157 mm (6.0 in) height

452 mm (17.8 in) width

553 mm (21.8 in) depth

DPO70000SX models, Rackmount configuration

177 mm (7.0 in) height

440 mm (19.75 in) width

523 mm (20.6 in) depth (from rack mounting ear to back of instrument)

Weight

DPO70000SX models 19 kg (42 lbs) oscilloscope only

Cooling

Required clearances

Fan-forced air circulation with no air filter	
Top	0 mm (0 in)
Bottom	6.35 mm (0.25 in) minimum or 0 mm (0 in) when standing on feet, flip stands down
Left side	76 mm (3 in)
Right side	76 mm (3 in)
Rear	0 mm (0 in) on rear feet

Environmental specifications

Temperature

Operating +5 °C to +45 °C

Nonoperating -20 °C to +60 °C

Temperature

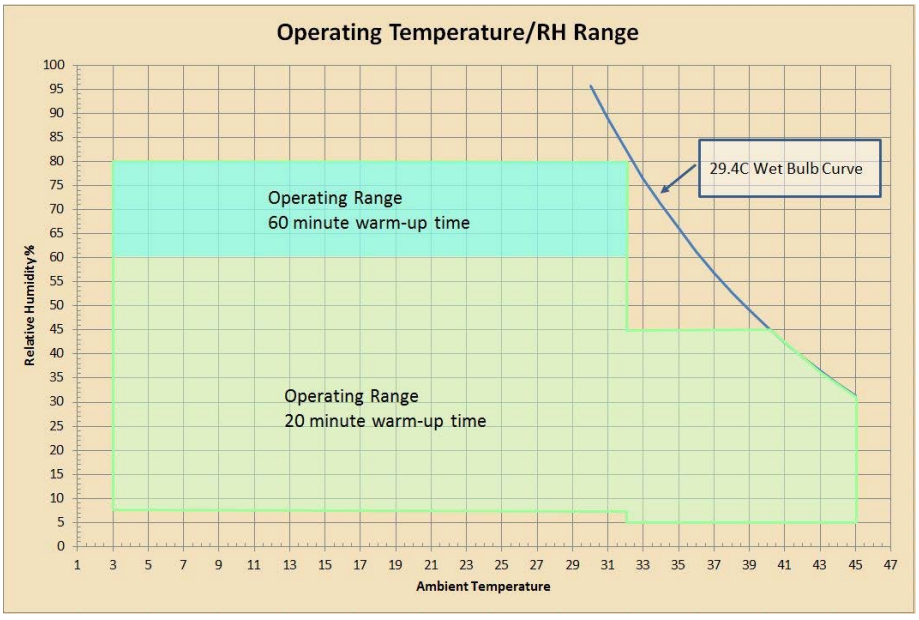
Operating +5 °C to +45 °C (41 °F to +113 °F), with 11 °C per hour maximum gradient, noncondensing, derated 1 °C per 300 meters (984.25 feet) above 1500 meters (4921.25 feet) altitude

Nonoperating -20 °C to +60 °C (-4 °F to +140 °F), with 20 °C/hour maximum gradient

Humidity

Operating 8% to 80% relative humidity at up to +32 °C (+90 °F)

5% to 45% relative humidity above +32 °C (+90 °F) up to +45 °C (+113 °F), noncondensing, and is limited by a maximum wet-bulb temperature of +29.4 °C (+85 °F) (derates relative humidity to 32% at +45 °C (+113 °F)



Nonoperating 5% to 95% relative humidity at up to +30 °C (+86 °F),

	5% to 45% relative humidity above +30 °C (+86 °F), up to +60 °C (+140 °F), noncondensing, and is limited by a maximum wet-bulb temperature of +29.4 °C (+85 °F) (derates relative humidity to 11% at +60 °C (+140 °F))

Altitude	
Operating	Up to 3,000 meters
Nonoperating	Up to 12,000 meters
Altitude	
Operating	Up to 3,000 meters (9,843 feet), derate maximum operating temperature by 1 °C per 300 meters (984.25 feet) above 1500 meters (4921.25 feet) altitude
Nonoperating	Up to 12,000 meters (39,370 feet)

Regulatory	
Electromagnetic compatibility	2004/108/EC; EN 61326-2-1
Certifications	UL 61010-1, CSA 61010-1-04, LVD 2006/95/EC, EN61010-1, IEC 61010-1

Ordering information

Models

DPO77002SX	70 GHz ATI Performance Oscilloscope
DPO75902SX	59 GHz ATI Performance Oscilloscope
DPO75002SX	50 GHz ATI Performance Oscilloscope
DPO73304SX	33 GHz Digital Phosphor Oscilloscope
DPO72504SX	25 GHz Digital Phosphor Oscilloscope
DPO72304SX	23 GHz Digital Phosphor Oscilloscope
DPO72004SX	20 GHz Digital Phosphor Oscilloscope
DPO71604SX	16 GHz Digital Phosphor Oscilloscope
DPO71304SX	13 GHz Digital Phosphor Oscilloscope

Systems

The following DPS systems provide single-nomenclature ordering convenience for 2 instruments and a 1 meter UltraSync cable. The same options may be applied to these systems as with base models and the option will be included on both instruments. Both component instruments will have the same options associated with the system nomenclature when operating standalone.

DPS77004SX	70 GHz ATI Performance Oscilloscope System: 2 x 70 GHz, 200 GS/s or 4 x 33 GHz, 100 GS/s
DPS75904SX	59 GHz ATI Performance Oscilloscope System: 2 x 59 GHz, 200 GS/s or 4 x 33 GHz, 100 GS/s
DPS75004SX	50 GHz ATI Performance Oscilloscope System: 2 x 50 GHz, 200 GS/s or 4 x 33 GHz, 100 GS/s
DPS73308SX	33 GHz Digital Phosphor Oscilloscope System: 4 x 33 GHz, 100 GS/s or 8 [4] x 23 GHz, 50 GS/s

Standard accessories

ATI channel accessories

Accessory	Tektronix part number
1.85mm, female to 2.92mm, female adapter	103-0483-00
Attenuator 2.92 mm Female to 2.92 mm Male. 50 Ω, 10 dB, 2 Watts, DC-40 GHz	011-0221-00
ATI connector saver, 1.85 mm, female-female	103-0474-00
ATI protective cap	016-2101-00
Torque wrench	067-2787-00
Backing wrench card	003-1972-00

Instrument accessories

Accessory	Tektronix part number
Installation and Safety manual -- depends on language option	071-3357-xx
Front protective cover	200-5337-00
PCIe Host Port protective plug	200-5344-00
2nd ethernet port plug	200-5389-00
50 Ω terminator on Fast Edge with chain (2X)	131-9650-00
TCA292D (5X) (3X on ATI instruments)	TCA292D

Table continued…

[4] Maximum of 4 channels displayed on-screen. Access to additional channels data available through program interface.

Accessory	Tektronix part number
Static protection wrist strap	006-3415-05
Accessories pouch	016-2045-00
Best Practices manual	071-2989-04
RoHS info	071-2185-04
Calibration certification	001-1179-00
Cal cert envelope	006-8018-01
Power cord	Depends on option

Warranty

One-year warranty covering all parts and labor.

Instrument options, upgrades, and floating licenses

The following instrument options, upgrades, and floating licenses are available as indicated.

- **Instrument:** An "Instrument" option is an option available at the time of purchase. When ordering an option for a new instrument the option is prefaced by the model number. For example, **DPO73304DX DJA**.
- **Upgrade:** An "Upgrade" is an option available to an existing instrument. When ordering an option as an upgrade the option is prefaced by DPO-UP. For example, **DPO-UP DJA**.
- **Floating license:** Floating licenses offer an alternative method to manage your Tektronix asset. Floating licenses allow license-key enabled options to be easily moved among all your DPO70000SX or MSO/DPO70000DX Series oscilloscopes. When ordering a floating license, the license is prefaced by DPOFL. For example, **DPOFL-DJA**. Check *www.tek.com/products/oscilloscopes/floating-licenses* for additional information about floating license options.

Record Length options, upgrades, and floating licenses

The following Record Length options, upgrades, and floating licenses are available. An "X" indicates the item is available. A "-" indicates the item is not available.

Option	Description	Instrument	Upgrade	Floating license
10XL	Extended record length: 125 M/Ch	X	-	-
20XL	Extended record length: 250 M/Ch	X	-	-
50XL	Extended record length: 1 G/Ch (2 Channels) 500 M/Ch (4 Channels)	X	-	-
XL010	Extended record length: Upgrade from standard to 10XL (125 M/Ch)	-	-	X
XL020	Extended record length: Upgrade from standard to 20XL (250 M/Ch)	-	-	X
XL050	Extended record length: Upgrade from standard to 50XL (1 G/Ch (2 Channels) 500 M/Ch (4 Channels))	-	-	X
XL510	Extended record length: Upgrade from 5XL (62.5 M/Ch) to 10XL (125 M/Ch)	-	X	-
XL520	Extended record length: Upgrade from 5XL (62.5 M/Ch) to 20XL (250 M/Ch)	-	X	-
XL550	Extended record length: Upgrade from 5XL (62.5 M/Ch) to 50XL (1 G/Ch (2 Channels) 500 M/Ch (4 Channels))	-	X	-
XL1020	Extended record length: Upgrade from 10XL (125 M/Ch) to 20XL (250 M/Ch)	-	X	-
XL1050	Extended record length: Upgrade from 10XL (125 M/Ch) to 50XL (1 G/Ch (2 Channels) 500 M/Ch (4 Channels))	-	X	-
XL2050	Extended record length: Upgrade from 20XL (250 M/Ch) to 50XL (1 G/Ch (2 Channels) 500 M/Ch (4 Channels))	-	X	-

Storage options and upgrades

The following Storage options and upgrades are available. An "X" indicates the item is available. A "-" indicates the item is not available.

Option	Description	Instrument	Upgrade
SSD	Solid State Drive Assembly: Additional customer-installable removable drive with Microsoft Windows 10 OS, TekScope and applications software installed	X	-

Trigger and Decode options, upgrades, and floating licenses

The following Trigger and Decode options, upgrades, and floating licenses are available. An "X" indicates the item is available. A "-" indicates the item is not available.

Option	Description	Instrument	Upgrade	Floating license
SR-6466	64b/66b Serial Triggering and Analysis (Requires Opt. ST14G)	X	X	-
SR-COMP	Computer Serial Triggering & Analysis (RS232/422/485/UART)	X	X	X
SR-DPHY	MIPI D-PHY (DSI1 / CSI2) Serial Analysis	X	X	X
SR-EMBD	Embedded Serial Triggering and Analysis (I2C, SPI)	X	X	X
SR-ENET	Ethernet Serial Analysis (10BASE-T and 100BASE-TX)	X	X	X
SR-PCIE	PCI Express Serial Triggering (Gen 1, 2) and Analysis (Gen 1, 2, 3, 4)	X	X	X
SR-USB	USB Serial Triggering and Analysis	X	X	X
SSIC	SSIC Protocol Decoder	X	-	X
ST14G	High-Speed Serial Trigger and Decode up to 14.1Gb/s. Supports NRZ patterns and 8b10b serial buses.	X	X	X
VET	Visual Trigger and Search	X	-	X
VETU	Visual Trigger and Search (for 70K Series >12 GHz)	-	X	-

Advanced Analysis options, upgrades, and floating licenses

The following Advanced Analysis options, upgrades, and floating licenses are available. An "X" indicates the item is available. A "-" indicates the item is not available.

Option	Description	Instrument	Upgrade	Floating license
100G-TXE	TekExpress 100G-TXE - 100Gbps TX Compliance Solution and DPOJET: CAUI4-TX, KR4-TX & CR4-TX	X	X	X
10G-KR	TekExpress 10G-KR - 10G-KR Compliance Solution and DPOJET: 10G-KR measurements plug-in. (Requires Opt. DJA)	X	X	X
400G-TXE	TekExpress 400G-TXE - 400G Electrical Tx Compliance Solution & DPOJET: CAUI4-TX measurements plug-in. Supports IEEE-802.3bs/cd: 400GAUI/200G-KR/CR & OIF-CEI (VSR/MR/LR). (Requires Opt. DJA, DJAN, PAM4, SDLA64)	X	X	X
40G-CR4	TekExpress 40G-CR4 - 40GBase-CR4 Compliance Solution and DPOJET: 40GBase-CR4 measurements plug-in. Suports IEEE 802.3-2012: Section 85. (Requires Opt. DJA)	X	X	X
AUTOEN10	TekExpress Automotive Ethernet - 10BASE-T1S Compliance Solution	X	X	X
AUTOEN10G	TekExpress Automotive Ethernet - MultiGBASE-T1 Compliance Solution (Requires Opt. DJA)	X	X	X
BITERR	High Speed Serial Bit Error Rate Detector up to 14.1Gbps (Does not include Frame Error Detector. For 70KSX models only.) (Requires Opt. ST14G)	X	X	X

Table continued…

Option	Description	Instrument	Upgrade	Floating license
BRR	TekExpress Automotive Ethernet - 100BASE-T1: 1000BASE-T1 Compliance Solution	X	X	X
CIO	DPOJET: CIO Tx/Rx Measurement Plugin. Supports DP2.0, TBT3, USB4 (Requires Opt. DJA)	X	X	X
CMENET3	TekExpress Ethernet - 10/100/1000 BASE-T Compliance Solution	X	X	X
CMENET3A	TekExpress Ethernet - 10/100/1000 BASE-T Compliance Solution (Requires Opt. ET3)	-	X	X
CPHY20	TekExpress MIPI C-PHY 2.0 Tx Compliance Solution (Requires DJA)	X	X	X
DDR-LP4	DPOJET: LPDDR4 Tx Electrical Validation Solution (Requires Opt. DJA, DDRA)	X	X	X
DDR5SYS	TekExpress DDR Tx - DDR5 System Level Tx Compliance/Debug Automation Solution. (Requires Opt. DJA, SDLA64, VET)	X	X	X
DDRA	DPOJET: DDR Tx Electrical Validation Solution - Supports DDR, DDR2, DDR3, DDR3L, DDR4, LPDDR, LPDDR2, LPDDR3, GDDR3, GDDR5 (Requires Opt. DJA)	X	X	X
DJA	DPOJET Jitter and Eye Analysis Tools - Advanced	X	-	X
DJAU	DPOJET Jitter and Eye Analysis Tools - Advanced (for 70k Series >12 GHz)	-	X	-
DJAN	DPOJET Jitter and Eye Analysis Tools - Noise (Requires Opt. DJA)	X	X	X
DP12	TekExpress DisplayPort - DisplayPort 1.2 Tx Compliance Solution (Requires Opt. DJA)	X	X	X
DP14	TekExpress DisplayPort - DisplayPort 1.4 Tx Compliance Solution (Requires Opt. DJA, SDLA, DP12)	X	X	X
DP20	TekExpress DisplayPort 2.0 Tx Compliance/Debug Solution (Requires Opt. CIO, DJA, SDLA)	X	X	X
DPHY12	TekExpress MIPI D-PHY 1.2 Tx Compliance Solution (Requires Opt. DJA)	X	X	X
DPHY21	TekExpress MIPI D-PHY 2.1 Tx Compliance Solution (Requires Opt. DJA)	X	X	X
EARC21RX	HDMI 2.1 eARC Advanced Analysis and Compliance software for Rx tests	X	X	-
EARC21TX	HDMI 2.1 eARC Advanced Analysis and Compliance software for Tx tests	X	X	-
EDP	DPOJET: Embedded DisplayPort 1.2 Tx Measurement Plugin (Requires opt. DJA)	X	X	X
EDP14	DPOJET: Embedded DisplayPort 1.4 Tx Measurement Plugin (Requires opt. DJA)	X	X	X
FRQCNT	Frequency Counter-Timer	X	X	X
HD21	TekExpress HDMI 2.1 Tx Compliance Solution (Requires Opt. DJA)	X	X	-
HD21DS	TekExpress HDMI 2.1 Rx Compliance Solution (Requires Opt. HD21)	X	X	X
HD21DSM	TekExpress HDMI 2.1 Rx Electrical and Protocol Compliance Pattern Generation and Calibration Solution (Requires Opt. HD21DS)	X	X	X
HDM	TekExpress HDMI 2.0 Tx Compliance Solution (Requires Opt. DJA)	X	X	X
HDM-DS	TekExpress HDMI 2.0 Rx Compliance Solution. Includes Rx tests for HDMI 1.4 using AWG70k. (Requires Opt. HDM)	X	X	X
HSSLTA	High Speed Serial Link Training Analysis for Ethernet Links	X	X	X
HT3	TDSHT3 - HDMI 1.4 Compliance Test Software	X	X	X
HT3DS	TDSHT3 - HDMI 1.4 Compliance Test Software Rx option (Requires Opt. HT3)	X	X	X

Table continued…

Option	Description	Instrument	Upgrade	Floating license
LPDDR5SYS	TekExpress DDR Tx - LPDDR5 System Level Tx Compliance/Debug Automation Solution. (Requires Opt. DJA, SDLA64, VET)	X	X	X
LT	Waveform Limit Testing	X	X	X
MPHY40	TekExpress MIPI M-PHY HS-Gear1, Gear2, Gear3, and Gear4 Tx Compliance Solution (Requires Opt. DJA and SDLA64)	X	X	X
MPHY50	TekExpress MIPI M-PHY HS-Gear1, Gear2, Gear3, Gear 4, and Gear5 Tx Compliance Solution (Requires Opt. DJA and SDLA64)	X	X	X
MHD	MHL Advanced Analysis and Compliance Software (Requires Opt. DJA, 2XL or higher)	X	X	X
NBASET	TekExpress Ethernet TX - NBASE-T Compliance Solution. Supports IEEE P802.3bz: Section 16; NBASE-T	X	X	X
PAMJET-E	PAM4 Transmitter Analysis Software for electrical signals (Requires Opt. DJA, DJAN)	X	X	X
PAMJET-O	PAM4 Transmitter Analysis Software for Optical signals (Requires Opt. DJA, DJAN)	X	X	X
PAMPCIE6	PAM4 measurement analysis package for PCIe Gen6 (Requires Opt. PAMJET-E)	X	X	X
PCE3	TekExpress PCIe Tx Compliance Solution and DPOJET: PCIe Tx Measurement Plugin. Supports PCIe Gen1/2/3 (Requires Opt. DJA, SR-PCIE)	X	X	X
PCE4	TekExpress PCIe Tx Compliance Solution and DPOJET: PCIe Tx Measurement Plugin. Supports PCIe Gen 3/4 (Requires Opt. DJA, PCE3, SR-PCIE)	X	X	X
PCE5	TekExpress PCIe Tx Compliance Solution: Supports PCIe Gen5 (Requires Opt. DJA)	X	X	X
PCE6	PCI Express Gen6 TekExpress Compliance/Debug Automation Software (Requires Option DJA and PAMPCIE6)	X	X	X
SAS3-TSG	TekExpress SAS3 Tx Compliance Solution (Requires Opt. DJA, SAS3)	X	X	X
SAS3-TSGW	TekExpress SAS-3 Tx WDP Transmitter Measurements (Requires Opt. SAS3-TSG)	X	X	X
SAS4-TSG	DPOJET: SAS4 Tx Measurement Plugin (Requires Opt. DJA)	X	X	X
SATA-T-UP	TekExpress SATA Tx Compliance Solution (PHY/TSG/OOB Bundle: SW Option)	X	X	-
SATA-TSG	TekExpress SATA Tx Compliance Solution (PHY/TSG/OOB) (Requires Opt. DJA)	X	X	X
SC	SignalCorrect Cable, Channel, and Probe Compensation Software	X	X	X
SDLA64	Serial Data Link Analysis - Measurement Circuit De-embed, Simulation Circuit Embed, Transmitter & Receiver Equalization and Advanced Analysis and Modeling Tools	X	X	X
SFP-TX	TekExpress SFP+ QSFP+ Tx - Ethernet SFP+/QSFP+ Compliance Solution and DPOJET: SFP+/QSFP+ Tx measurements plug-in. (Requires Opt. DJA)	X	X	X
SFP-WDP	TekExpress SFP+ QSFP+ Tx - Waveform Distortion Penalty measurements (Requires Opt. SFP-TX)	X	X	X
SWX-DP	Switch Matrix support for DisplayPort 1.2 Tx (Requires Opt. DP12)	X	X	X
SWX-PCE	Switch Matrix support for PCIe Tx (Requires Opt. PCE, PCE3, PCE4)	X	X	X

Table continued…

Option	Description	Instrument	Upgrade	Floating license
TBT3	TekExpress Thunderbolt 3 & Thunderbolt 4 Tx Compliance/Debug Automation Solution (Requires Opt. CIO, DJA, SDLA64)	X	X	X
USB-TX	TekExpress USB 3.0 Tx Compliance Solution (Requires Opt. DJA)	X	X	X
USB-TX-UP	Upgrade TekExpress USB 3.0 dongle-based license to scope-based license	X	X	X
USB2	TekExpress USB 2.0 Automated Compliance Solution	X	X	X
USB4	TekExpress USB4 Tx Compliance and DPOJET: USB4 Tx/Rx Measurement Plugin Solution (Requires Opt. CIO, DJA, SDLA64)	X	X	X
USBSSP-TX	TekExpress USB 3.1 Tx Compliance Solution (5Gb and 10Gb) (Requires Opt. DJA, USB-TX)	X	X	X
XGBT2	TekExpress Ethernet Tx - 10GBASE-T Compliance Solution. Supports IEEE 802.3: Section 55	X	X	X

Spectral and Modulation Analysis options, upgrades, and floating licenses

The following Spectral and Modulation Analysis options, upgrades, and floating licenses are available. An "X" indicates the item is available. A "-" indicates the item is not available.

Option	Description	Instrument	Upgrade	Floating license
5GNR	5G NR Uplink/Downlink RF Power, Bandwidth, Demodulation and Error Vector Magnitude Measurments (Requires Opt. SVE)	-	X	-
SVE	SignalVu® Essentials - Vector Signal Analysis Software	X	-	X
SVEU	SignalVu Essentials - Vector Signal Analysis Software for 70k Series >12 GHz	-	X	-
SVA	AM/FM/PM Audio Signal Analysis (Requires Opt. SVE)	X	X	X
SVM	General Purpose Modulation Analysis (Requires Opt. SVE)	X	X	X
SVO	Flexible OFDM Analysis (Requires Opt. SVE)	X	X	X
SVP	Advanced Pulsed Signal Analysis including Measurements (Requires Opt. SVE)	X	X	X
SVT	Frequency and Phase Settling Time Measurements (Requires Opt. SVE)	X	X	X
SV23	WLAN 802.11a/b/g/j/p measurement application (Requires Opt. SVE)	X	X	X
SV24	WLAN 802.11n measurement application (Requires Opt. SV23)	X	X	X
SV25	WLAN 802.11ac measurement application (Requires Opt. SV24)	X	X	X
SV26	APCO P25 compliance testing and analysis application (Requires Opt. SVE)	X	X	X
SV27	SignalVu Bluetooth Basic LE TX SIG measurements (Requires Opt. SVE)	X	X	X
SV28	SignalVu LTE DownLink RF measurements (Requires Opt. SVE)	X	X	X
SV30	WiGig IEEE 802.11ad/ay transmitter testing (Requires Opt. SVE)	X	X	X

Other upgrades

Upgrade	Description
DPO7SXSSD-W10 DPO7SXSSD-W10 opt NOL (all 70kSX models except 70 GHz, order both line items)	Spare Solid State Drive - **Windows 10**, for oscilloscopes already licensed and running Win10. Preconfigured with OS, TekScope, and oscilloscope applications.

Table continued…

Upgrade	Description
DPO7SXSSD-W10 DPO7SXSSD-W10 opt UP (all 70kSX models except 70 GHz, order both line items)	Upgrade Solid State Drive - **Windows 10**, for oscilloscopes currently licensed and running Win7. Upgrades to Win10. Preconfigured with OS, TekScope, and oscilloscope applications.
DPO7SXSSD70GW10 DPO7SXSSD70GW10 opt NOL (only for 70 GHz models, order both line items)	Spare Solid State Drive - **Windows 10**, for 70 GHz oscilloscopes already licensed and running Win10. Preconfigured with OS, TekScope, and oscilloscope applications.
DPO7SXSSD70GW10 DPO7SXSSD-W10 opt UP (all 70kSX models except 70 GHz, order both line items)	Upgrade Solid State Drive - **Windows 10**, for oscilloscopes currently licensed and running Win7. Upgrades to Win10. Preconfigured with OS, TekScope, and oscilloscope applications.

Note: The part numbers for these drives are not DPO-UP options. Order the part numbers as they are listed above. Do not order DPO-UP for these drives.

Investment protection options

As signals get faster and new standards are developed, your investment in an DPO70000SX Series instrument can evolve with your needs. You can upgrade the bandwidth of the unit you own today. You can take advantage of DPO70000SX Series performance improvements by upgrading your existing unit to a new series. Contact your local Tektronix representative to discuss the full range of options available to ensure your DPO70000SX Series oscilloscope has the tools you need for your next project.

Power plug options

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)

Opt. G3	Complete Care 3 Years (includes loaner and more)
Opt. G5	Complete Care 5 Years (includes loaner and more)
Opt. IF	Upgrade Installation Service
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R5	Repair Service 5 Years (including warranty)

Recommended accessories

Probes

DPO7OE1	33 GHz optical probe
DPO7OE2	59 GHz optical probe
P7633	33 GHz Low Noise TriMode® Probe
P7625	25 GHz Low Noise TriMode® Probe
P7520A	25 GHz TriMode® probe
P7720	20 GHz TriMode probe with TekFlex™ connector technology
P7313SMA	13 GHz TriMode® differential SMA probe
P6251	DC to 1 GHz, 42 V, differential probe (requires TCA-BNC adapter)
TCPA300/TCPA400 Series	Current measurement systems
P5200/P5205/P5210	High-voltage differential probes
P77DESKEW	P7700 Probe Deskew Fixture for SMA, solder-down, and browser connections
067-2431-xx	Probe Deskew Fixture for SMA or solder-down connections (up to 30 GHz)
067-0484-xx	Analog Probe Calibration and Deskew Fixture (4 GHz)
067-1586-xx	Analog Probe Deskew Fixture (>4 GHz)
067-1686-xx	Power Deskew Fixture

Adapters

TCA-1MEG	TekConnect® high-impedance buffer amplifier. Includes P6139 A passive probe
TCA292D	TekConnect® to 2.92 mm adapter (33 GHz bandwidth)
TCA-BNC	TekConnect® to BNC adapter
TCA-N	TekConnect® to N adapter
TCA-VPI50	50 Ω TekVPI to TekConnect adapter
TCA75	23 GHz precision TekConnect® 75 Ω to 50 Ω adapter with 75 Ω BNC input connector

Signal Path Solutions

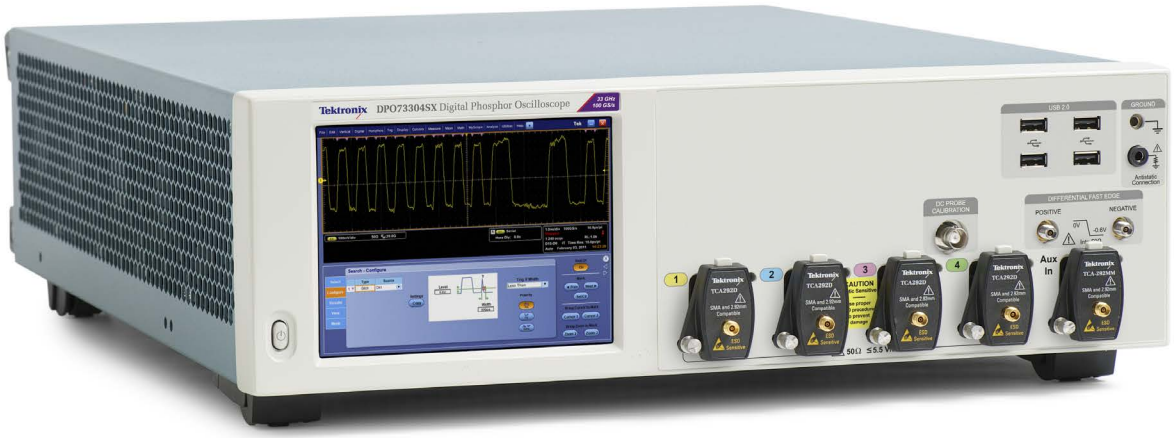
DPO7RFK1	3 dB, 6 dB, 10 dB, and 20 dB attenuator kit with 1.85 mm connectors, characterized to 70 GHz. Includes serial numbers and S-parameters for each attenuator.
DPO7RFK2	Includes the contents of the DPO7RFK1 plus a DC Block and 4 adapters for connecting to 1.85 and 2.92 mm fixtures.
DPO7RFK3	RF channel timing de-skew kit, 65 GHz, 1.85 mm. Kit includes a high performance power divider and 1.85 mm male-male adapter.

011-0187-00	Adapter, 1.85mm, male to 2.92mm, female
050-3854-01	Adapter, 1.85mm, female to 2.92mm, male. Includes S-parameter data.
050-3851-00	DC Block, 1.85mm, male-female. Includes S-parameter data.
174-6663-01	Cable; 2.92-to-2.92 mm cable pair, straight, 1.5 ps phase-matched, 500 mm, 40 GHz
PMCABLE1M	Phase matched cable pair, 40 GHz, 2.92mm, male-male, 1 meter.
174-6978-00	Cable; 2.92-to-2.92 mm cable pair, straight, 1.5 ps phase-matched, 2 m, 40 GHz
174-6664-01	Cable; SMA-to-SMA cable pair, straight, 1.5 ps phase-matched, 200 mm, 20 GHz
174-6665-01	Cable; SMA-to-SMA, single cable, right-angle, 300 mm, 20 GHz
174-6666-01	Cable; SMA-to-SMA, single cable, right-angle, 500 mm, 20 GHz
174-6667-01	Cable; SMA-to-SMA, single cable, right-angle, 1.829 m, 20 GHz
174-6658-01	Cable; SMP-to-SMP cable pair, right-angle, 2.5 ps phase-matched, 300 mm, 20 GHz
174-6659-01	Cable; SMP-to-SMP cable pair, right-angle, 2.5 ps phase-matched, 1 m, 20 GHz

Other

016-2095-xx	Rackmount Kit
016-2102-xx	SSD mounting kit (front of instrument rackmount tray)
077-0076-xx	Service Manual, pdf on hard drive
016-2104-00	Transit Case (carbon fiber)
K4000	Oscilloscope Cart
DPO7AFP	Auxiliary Front Panel
DPO7USYNC 1 M	1 meter UltraSync cable
DPO7USYNC 2 M	2 meter UltraSync cable

The DPO70000SX Series offers the highest performance (50/59/70 GHz models) in Tektronix' Real Time performance oscilloscope portfolio.



The DPO70000SX Series also offers 13 GHz, 16 GHz, 20 GHz, 23 GHz, 25 GHz, and 33 GHz models with 4 TekConnect inputs.

Tektronix is registered to ISO 9001:2015 and ISO 14001:2015.

GPIB IEEE-488

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit *www.tek.com*.

28 Oct 2025 55W-30662-30

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